PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited.

41 PARK ROW (TIMES BUILDING), NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

In requesting your address changed, give **old** *as well as new address.*

ESTABLISHED 15 YEARS AGO, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the LARGEST CIRCULATION of any electrical periodical in the world, and is the BEST ADVERTISING MEDIUM.

In the growth of THE ELECTRICAL WORLD, in circulation, size and general improvement, the **value of its columns for reaching those engaged in electrical pursuits** has not failed to be **appreciated by advertisers.**

The following table shows **the steady onward march** of the paper in this department of its business, notwithstanding the numerous recent consolidations among electrical companies:

The first issue of					1888 cont'ined		175	different	adv'ts.
1881 contained		28	different	adv'ts.	1889	"	234	"	"
1882	"	45	"	"	1890	"	289	"	"
1883	"	63	"	"	1891	"	325	"	"
1884	"	82	"	"	1892	"	316	"	"
1885	"	100	"	"	1893	"	317	"	"
1886	"	138	"	"					
1887	"	154	"	"					

No announcements of the Publisher are included in this list.

"WANT" AND "FOR SALE" ADVERTISEMENTS

are a special feature of **THE ELECTRICAL WORLD.** Position Wanted small advertisements cost but $1 an insertion; Help Wanted and For Sale small advertisements cost but $1.50 an insertion. Remit in advance for the number of insertions desired.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

41 Park Row, New York,

OR ANY OF THE BRANCH OFFICES.

VOL. XXII. NEW YORK, AUG. 5, 1893. NO. 6.

CONTENTS.

EDITORIAL: PAGE
Paragraphs ... 93

ILLUSTRATED ARTICLES:
An Alternating Current Problem, by W. D. Weaver ... 94
Technical Education in Europe—IV., by Frank C. Perkins ... 95
A Southern Electric Plant, by A. F. McKissick ... 96
Bell's Radiophone ... 97
The Exhibit of the New England Butt Company ... 98
Laboratory Notes, by Lieut. F. Jarvis Patten ... 98
The First Electric Launch on the Pacific Coast ... 99
Notes on the Electric Arc, with some Experiments on the Arc Under Pressure, by Dr. Louis Duncan, A. J. Rowland and R. T. Todd ... 101
Practical Aspects of Low Frequency Electrical Resonance, by M. I. Pupin ... 102
ELECTRICAL WORLD'S Digest of Current Technical Electrical Literature, compiled by Carl Hering ... 103
The Royal Alternating Current Dynamo ... 105
The "Perfect" Battery ... 105
A New Gate Valve ... 105
An Inclined Electric Passenger Elevator ... 105
A New Commutator Brush ... 106
A Dry Electropoion ... 106
A New Open Circuit Battery ... 106
A New Gravity Drop Cut-Off ... 106
A Street Lamp Shade and Reflector ... 106

MISCELLANEOUS:
Photographic Exposure of "The Western Electrician" and Its "Enterprise" ... 94
Is it "A Very Important Victory" ... 94
Incandescent Lamp Proceedings ... 94
International Electrical Congress ... 98
Quartz Fibres and Rods, by E. F. Northup ... 99
The Care of Motors for Electric Street Railways, by Lieut. J. B. Cahoon ... 99
The Electric Light and Power Transmission Plant at Pergina, Tyrol, Austria ... 100
Sir Francis Ronalds ... 102
Moonlight Tables for August, 1893 ... 102
Arc Lamps on Railway Circuits ... 106

FINANCIAL INTELLIGENCE, 107; Affairs of the Companies, 107; New Incorporations, 107.

SPECIAL CORRESPONDENCE: New York Notes, 107; New England Notes, 107; Pittsburgh Notes, 107; Western Notes, 107; English Notes, 108; German Notes, 108.

NEWS OF THE WEEK: The Telephone and Telegraph, 108; Electric Light and Power, 108; The Electric Railway, 108; Personal Notes, 108; Miscellaneous Notes, 108.

TRADE AND INDUSTRIAL NOTES ... 109
BUSINESS NOTICES ... 109
PATENT RECORD ... 109

An Austrian Water Power Electric Plant. WE give in the present issue an account of an Austrain water power light and power transmission plant which is of interest in view of the development in this direction now taking place in the United States. The rates for lights and power stated in the account are interesting, but it is difficult to see how the plant, even assuming the most favorable conditions, can be made to pay with the prices given. The system of charging a net price per year instead of using meters is a poor one, not only on account of the inequality of such a method, but also because it puts a premium on wastefulness in using the light and power.

Alternating Currents for Charging Storage Batteries. IN the Digest is an account of a French invention by means of which alternating currents may be used for charging storage batteries. While it is simple to merely re-dress an alternating current, *i. e*, have the E. M. F. always positive, such a current can not be practically used for this purpose owing to the E. M. F. during part of a phase being less than the counter E. M. F. of the battery. As will be seen from the description, the alternating current, by means of a special commutator on a small synchronous motor, is cut off during the period when its E. M. F. is below that of the counter E. M. F. of the battery. As by means of an adjustment of the brushes this may be done at the exact instant when the two E. M. Fs. are equal, sparking is consequently eliminated.

Motion in a Magnetic Field. ANOTHER rule has been added, by Mr. E. C. Rimington (see Digest), to the innumerable ones already in existence for determining the motion of a conductor conveying a current in a magnetic field, or the converse case. The author remarks that he always forgets other persons' rules and concludes by intimating that his own rule may be difficult to remember by others, so that it does not seem that much progress has been made in proposing it. The truth is that any arbitrary rule based entirely on an artificial conception is difficult to remember and also difficult to apply with confidence. In THE ELECTRICAL WORLD of July 1, Mr. B. B. James gives a principle which is vastly superior to rules of the above character, and only implies a knowledge of the direction of the lines of force about a conductor carrying a current. Knowing this direction and the direction of the lines of force of the magnetic field, the rule is that, *the conductor will move toward the side on which its own lines of force and those of the field tend to go in opposite directions.* This principle can be applied to all cases, and as its application may be easily deduced from a simple diagram with little or no ambiguity, its superiority is evident.

A Single-Phase Motor. THE importance of a single-phase motor working without rings, commutator or brushes, and which can be brought to synchronism by simply temporarily closing a switch, is so obvious that the description by Lieutenant Patten in another column of such a motor deserves the most careful consideration. We saw the experimental motor referred to, which in a very few seconds after closing the secondary or auxiliary circuit arrived at synchronism, after which the brushes of this circuit were removed without affecting the operation of the motor. The circuit of the revolving portion may be closed on itself by a simple mechanism on the shaft, so that the claim of a single-phase motor working without rings, brushes or commutator is valid. On account of the operating current being in the stationary part of the motor, the primary alternating current may be used in it without any danger. As the current for bringing to synchronism is small there is no appreciable sparking, and the transformer for this purpose will, of course, be small and is only in use when starting; the voltage of this current can be made as low as desirable, so that the brushes during the few seconds they are in use may be handled with impunity. Another important feature claimed for the motor is that it may be designed for any rate of alternations, even to the highest in common use.

The Counter E. M. F. of the Electric Arc. MUCH has been written on the counter E. M. F. of the electric arc and a number of formulas proposed to express its value, all of which have heretofore been more or less unsatisfactory. In another column we print a notable contribution to the subject, and as the assumptions involved have been, as far as possible, experimentally tested with satisfactory results, the formula appears to be the most rational yet advanced. Owing, however, to several causes (to which the writers refer) influencing the entire E. M. F. of the arc, and which are probably impossible of exact expression, the constants themselves, if such they may be called, will vary to such an extent as to render this formula when numerically applied to a given case of little value, as intimated in the article. Among these causes are the variation in the section of the arc, in the temperature of the negative carbon and in the rapidity of vaporization, depending upon the kind and size of carbon used; the first affects the ohmic resistance of the arc, the second the thermo-electric couple, and the third both the E. M. F. of vaporization and the ohmic resistance. The discussion and experiments, nevertheless, are very interesting and go far toward definitely establishing the theory of the electric arc. The existence of two counter E. M. Fs. acting jointly, one due to the vaporization of the carbon and the other due to the thermo-electric couple resulting from the different temperatures of the two carbon points joined by the carbon vapor, seems, now that it has been experimentally demonstrated, entirely obvious, a criterion which shows when a subject has been both firmly established and clearly expounded.

The Care of Street Railway Motors. IN another of Lieut. Cahoon's eminently practical articles on the care and management of electrical machinery, which we print in another column, the subject of street railway motors is considered, and an excellent system of inspection mapped out. The present slipshod attention too often given to electrical machinery is perhaps natural under the circumstances, being due to a lack of appreciation of the requirements of the case, or rather refusal to recognize that other requirements are necessary than what has been applied to other cases familiar to those concerned. Because other classes of machinery apparently do not require frequent formal inspections, it may be thought that it is unnecessarily exacting to require the inconvenient and often laborious inspections recommended by those qualified to speak in regard to street railway motors. Yet, a little reflection will show that other classes of machinery under great strain, or subject to considerable wear, or requiring frequent adjustment, receive attention corresponding to that asked in the case in question. A locomotive, for example, is thoroughly inspected after each run, and it may be observed that if a train stops long enough to give the engineer an opportunity, he invariably takes a "look around." The marine engine of an Atlantic liner, besides being constantly under the most minute inspection while under way, is extensively overhauled for this purpose when it reaches port, and upon return to the home port is placed in the hands of a gang of machinists, at the end of each voyage, when every part is inspected, adjusted and repaired. Of course, the cases are not parallel, but the great wear to which street railway motors may be subjected, the liability there is of nuts becoming loosened, and the necessity of proper attention to the commutator and brushes, leaving aside the purely electrical features, are all matters that require constant looking after, and it will not take many years for experience to teach this in a costly manner if neglected.

The Management of Storage Batteries. AN abstract in the Digest of last week from a French writer on guaranteeing accumulators contains some excellent advice, particularly if considered with reference to the use of storage cells with isolated plants, or wherever expert attendance is lacking. In these cases the use of a magnetic maximum current cut-out in the discharging circuit should be insisted upon, and the addition of a cut-out that would not permit the battery to be discharged after it had fallen below a certain voltage would be another valuable safeguard. The storage battery is a useful adjunct to many isolated plants, but little advantage has been taken of this fact on account of the many unfortunate experiences in its use, which, in almost every case, can probably be traced to improper management. A number of instances can be given in which storage batteries, in connection with lighting plants, have after long use demonstrated that they are perfectly reliable and have entirely fulfilled the expectations of the purchaser, but in these cases, of course, they have received proper usage. It is now generally held that overcharging does not injure storage batteries, the excess of current merely causing simple electrolysis; as this is accompanied, however, by ebullition and spraying, thus depleting the solution and exposing connections and wires to corrosive action, besides spreading disagreeable fumes, the use of a magnetic cut-out in the charging circuit is advisable. There is almost a necessity, however, for a magnetic cut-out in the discharging circuit. The temptation to add lights here and there after a plant is installed is great, and the use of unnecessary lights should have a check when there is a call for more than the usual number on special occasions. Fuses are not sufficiently reliable or close in action for this purpose, and they can be changed to a larger size without detection where this could not be done with a magnetic cut-out. Besides exceeding the rate of discharge another abuse of storage batteries, which is perhaps more frequent, arises from under-discharging them, thus causing sulphating. To prevent this there should be a magnetic cut-out that would be actuated in case the voltage falls below a certain amount, say 1.8 volts per cell with lead batteries. A plant equipped with these two safety devices could be placed in inexperienced hands with every prospect of giving proper satisfaction, where without them there would almost certainly be another case of failure. With this system it is probable that at first the building lighted will be suddenly left several times in darkness, but the extra attention that would follow would more than justify this contingency. The introduction of automatic regulating resistances into the circuits, recommended by M. Leroy, would add too much to the cost and complication of an ordinary plant, but the plan of displacing the regulating cells by a resistance is a good one and perfectly practicable. The introduction of a resistance would reduce the efficiency of the plant somewhat, about five per cent., but would do away with the bothersome feature that accompanies regulating cells. Owing to the different lengths of time these are in the discharging circuit, it is troublesome to keep track of them when charging, usually necessitating frequent visits to the battery room, and when neglected their spraying is a disagreeable feature. As they are seldom looked after as closely as the other cells and are more liable to short circuits, it sometimes happens that their plates are the first to give out. These points are of especial interest at the present time since there is now a prospect that the storage battery industry will receive the development that has been prevented heretofore by litigation.

Photographic Exposure of "The Western Electrician" and Its "Enterprise."

Our blue-covered Windy City contemporary probably does not feel as proud as it did at first over its alleged "enterprise" (save the mark) in being the first to publish a photograph of the Edison tower of light.

It devotes nearly a column and a half of its editorial page in its issue for July 22 to (1) an explanation of how it obtained the photograph, not only in advance of the other electrical journals, but also in advance of the General Electric Company, for which it was made, and (2) in an effort to show that this exploit demonstrated "enterprise" on its part.

The "Western Electrician" gets so excited over its "explanation" or confession that it asks for it two very unfortunate questions, viz.:

"How did we '(it)' present the first picture of the new Westinghouse lamp when the electrical fraternity of the whole world was eager to see it? and, How did we '(it)' get the photograph, indeed!" and adds "We have no desire to point to these results in a boastful spirit."

We should hope not, for the first result was obtained by a most direct violation of confidence, which caused our contemporary to forfeit the friendship of its confidant, and the second was obtained by no less a display of "enterprise" than working on the cupidity of a World's Fair official, if such the official photographer can be called.

The photograph of the tower of light, according to Lieutenant Spencer, was made for and on the order of the General Electric Company. The Lieutenant says that he gave the official photographer distinct instructions to deliver no copy of the photograph to any one without a written order from him. The "Western Electrician" says that "no restriction was placed on the official photographer by the representative of the General Electric Company," however, it happens to know. It adds that it had an order with the official photographer for a photograph of the tower, and that to save himself the trouble of making a second negative he gave it a print from the negative he had taken for the General Electric Company.

Our contemporary tries to make a point for itself and to excuse its conduct or the conduct of the official photographer in the matter by denying that the General Electric "paid" for the photograph. Of course it did not pay for it. Why should it, after the official photographer had prostituted all sense of business honor and obligation by selling it first to the "Western Electrician," days before copies of it were delivered to the General Electric for which it was made?

The "Western Electrician" probably knew very well that if it had sent the official photographer to make a negative of the tower of light, he would not have been allowed to make it. The official photographer, after what he had done had become known, would have been unwise to have presented a bill to Lieutenant Spencer, and the latter would have been more unwise still to have paid it.

If the negative was taken for the General Electric Company, either with or without instructions, what business had our contemporary with it in its possession? If it was made for one person, what right had the photographer to give it to another, even though by so doing he saved himself another trip?

When photographs are taken to order the cost is $3 each, although the same sized photographs from stock cost but $1 apiece. A photograph made to order ought, one would think, to be the property of the person for whom it is made, and copies should not be sold by the official photographer—especially days before it is delivered to those for whom it was made—without express permission.

Just where the "enterprise" of the "Western Electrician" comes in, either in the matter of this photograph, or of the other unfortunate case it cites—the Westinghouse lamp—THE ELECTRICAL WORLD frankly confesses it cannot see. Even a consultation of the Century Dictionary does not enlighten us on the subject. This authority defines Enterprise as "an adventurous and enterprising spirit; disposition or readinesss to engage in undertakings of difficulty, risk or danger, or which require boldness, promptness and energy."

In what possible way does this definition apply to what the "Western Electrician" did, either in reference to the Westinghouse lamp or the Edison tower?

The whole matter reminds us of a story we recently read in one of the Chicago dailies. A newsboy with a frescoed face climbed on a street car in the World's Fair city—not an electric car, let us hope—and asked the conductor to change a nickel for him. The conductor took the nickel, punched a hole in his half-fare slip, and handed the newsboy two cents change.

"Where's de tree cents?" demanded the boy.

"The three cents is all right, sonny."

"But I didn't want to ride."

"What did you get on for?"

"I wanted to git de change for a customer."

"That's all right," said the conductor, putting his tongue in his cheek and winking at the passengers. "You've got your change and you've paid your fare. You can stay on as long as you please."

The boy, with something in his eyes that made him wink and something in his throat that choked him, got off and ran back.

But let us not waste any sympathy on him, adds the Chicago daily. He was only a newsboy with a frescoed face. Let us admire the conductor, who chuckled over his little joke for the next two blocks, because there was nobody in the car big enough to knock him down.

It is a burning shame if connected with the World's Columbian Exposition there is not somebody big enough *ex officio* to, metaphorically speaking, knock down an official photographer who, even "to save himself the trouble of making another negative" would do what was done in this case.

To Lieutenant Spencer the different electrical journals naturally look for an explanation in this matter. He assured them that they would each get the photograph at the same time. It might be pertinent to ask here what action the Lieutenant has taken to protect himself against future violations of a similar character? Has he taken steps to bring this matter before the proper authorities, and if so, what? These are questions we would like to have answered, as they concern others than ourselves—others more than ourselves, for we have little resort to photography in the illustration of our World's Fair matter—but we want to know what assurance the authorities can give us that when they compel us to patronize their official photographer the photographs we order may not be delivered to others before we get them.

Is It "A Very Important Victory"?

The official statements sent out by the General Electric as to its financial condition do not appear to have very much weight either in Wall street or with investors. There must, of course, be some reason for this.

On Saturday a "statement" was given out to the press by the General Electric in these words:

> The General Electric Company yesterday secured restraining orders from Judge Ricks, of the U. S Circuit Court, Northern District of Ohio, against the Buckeye Electric Company and the Packard Electric Lamp Company of Ohio, manufacturers of incandescent lamps. This is a further and very important victory for the Edison lamp patent.

It is a question whether the want of confidence in the General Electric may not be caused in great part by just this class of "statement."

Every Wall street man and every intelligent investor knows that in a case of this kind a Judge will issue such a restraining order as that mentioned as a matter of course, without even notifying the other side. There is certainly no "very important victory" in the obtaining of such an order, than it would be "a very important victory" for a person against whom suit has been brought being allowed to appear by counsel to defend the action.

Incandescent Lamp Proceedings.

The Edison Illuminating Company, of New York, on July 27 brought suit in the United States Circuit Court against the Mount Morris Electric Light Company and the United Electric Light and Power Company for injunctions restraining these companies from using infringing lamps, and asking for an accounting of profits. On June 30 similar suits were brought against a private user of infringing lamps and against the Holland House and the Imperial Hotel; an absolute injunction was granted against the former, and 30 days were allowed to the others, who will come before the court on Aug. 1, at the same time as the competing companies.

It is reported that the proprietor of the Imperial Hotel made arrangements with the Edison Illuminating Company for the purchase of lamps by signing a contract for a number of years.

Mr. G. M. Pinney, Jr., counsel for the Holland House, states that after the injunction proceedings, application was made by the Holland House to the Edison Illuminating Company to purchase Edison lamps for cash on delivery at market rates. In reply, the said company refused to furnish the lamps except on the basis of the hotel taking current from the Edison mains at the usual rates. As the Holland House has a plant of its own, purchased from the Westinghouse company previous to Judge Wallace's decision sustaining the Edison lamp patent, this was brought to the attention of the Edison Illuminating Company, who merely reiterated its offer to supply current to the hotel from their mains, and indirectly refused to sell lamps. As the Illuminating company is the sole licensee for the sale of Edison lamps in New York below Seventieth street, and as current from the Edison mains would have increased the yearly cost of lighting $20,000 over the cost of using the isolated plant, the proprietor of the hotel accepted an offer to take 25 Westinghouse stopper lamps on trial. These proved so satisfactory that the entire hotel has been equipped with Westinghouse lamps, and 3,200 are now in use, with the most satisfactory results. As bearing on the refusal to sell lamps, Mr. Pinney called attention to the decision of the Circuit Court of Appeals of Dec. 19, 1893, sustaining Judge Wallace's preliminary injunction of July 21, 1891, in favor of the Edison lamp patent. The decision gave to the defendants the right to move for the suspension or modification of the injunction upon proof of specific instances of refusal on the part of the Edison company to supply lamps of the patent sustained upon terms reasonable under the circumstances of the particular case to owners of electric light apparatus which was installed or purchased prior to Judge Wallace's decision.

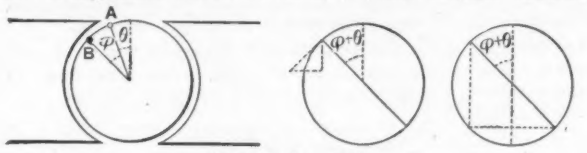
It is reported that the appeal in the Oconto lamp suit will probably be heard early in October, if not before. An attempt will be made to have the Circuit Court of Appeals convene before October, but in any event the appeal will have precedence as a preferred case.

An Alternating Current Problem.

BY W. D. WEAVER.

In one of E. Arnold's articles in The Electrical World the statement is made that if the current of one of two alternators rigidly coupled is used to excite the field of the other one the E. M. F. of the second alternator will have twice the periodicity of that of the first.

To investigate this, assume that the first alternator, A, has its field excited by a continuous current, and that the resulting alternating current follows the sine law. To simplify the case, let Fig. 1 represent the equivalent in action of two poles of an alternator, and consider both alternating circuits free from any action that would distort or lag either curve of E. M. F., and further assume



FIGS. 1, 2 AND 3.

that the field of B will vary in strength directly with the exciting current.

In Fig. 1 the open circle on the circumference of the armature represents a coil on alternator A, and the filled circle one on alternator B; the angle the first coil has advanced beyond its neutral position is denoted by θ and the angle between corresponding coils on the armatures by φ.

As the field of alternator B is due to an alternating current, its coil will have two E. M. Fs. induced in it, one due to its cutting lines of force as a dynamo coil, and another from the varying field causing it to act as a transformer coil, and the efficient E. M. F. will be the resultant of these two.

First, consider the dynamo induction, which will be the product of the field H, by the rate dv at which the lines of force are cut, or H dv, neglecting the various dimensions, as the result desired is merely comparative. Assuming the current supplied by the alternator A to the field of B to vary according to the law $i = \sin \theta$, the strength of the field at any instant is $\sin \theta$; referring to Fig. 2 it will be seen that the rate of cutting, dv, is $\sin (\varphi + \theta)\, d\theta$, so that we have finally for the dynamo induction at any instant the value

$$d e_d = \sin \theta \sin (\varphi + \theta)\, d\theta$$

and the total dynamo E. M. F. at that instant is

$$E_d = \int d e_d = -\frac{\sin \theta}{2} \cos (\varphi + \theta) \qquad (1)$$

Next, consider the transformer induction, which will be the product of the opening of the coil at any instant by the variation of the flux at that instant. The variation of flux

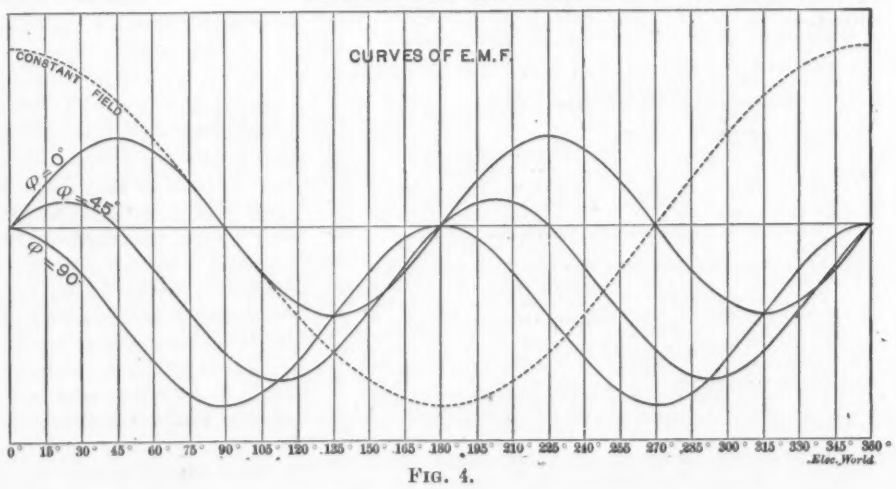


FIG. 4.

will be $di = \cos \theta\, d$, and, referring to Fig. 3, it will be seen that the opening of the coil is $\cos (\varphi + \theta)$. The transformer induction, therefore, at any instant has the value

$$d e_t = \cos \theta \cos (\varphi + \theta)\, d\theta$$

and the total transformer induction at that instant is

$$E_t = \int d e_t = \frac{\sin \theta}{2} \cos (\varphi + \theta) \qquad (2)$$

The difference between (2) and (1) is the efficient E. M. F. $= \sin \theta \cos (\varphi + \theta)$.

Curves of E. M. F. from this formula, for different values of φ as given, are plotted in full lines in Fig. 4; the dotted curve shows what the curve of E. M. F. would be if the field were constant. As will be seen, the curves when φ is 0 degree or 90 degrees are symmetrical and have twice the periodicity of the dotted curve; for values of φ between 0 degree and 90 degrees the curve is not symmetrical, and becomes less and less so as φ approaches 90 degrees in value. For higher values of θ the curves of the first two quadrants are duplicated.

Technical Education in Europe.—IV.

BY FRANK C. PERKINS.

KÖNIGLICH BAYERISCHEN TECHNISCHEN HOCHSCHULE ZU MÜNCHEN.

The Electro-Technical Institute of the Polytechnicum (see illustration) at München has from 70 to 100 students registered for lectures and from 30 to 40 registered for laboratory work. The total number of students in the Polytechnicum is between 900 and 1,000. The building is a fine stone structure, situated on Arcis Strasse opposite the Alte Pinakothek.

The lectures in electrical engineering are given by Prof. E. von Voit, who has charge of the laboratories and the entire electro-technical work. Here, as in many other institutions of like character, the electrical engineers are expected to take the same general course of studies and the same laboratory practice as the mechanical engineers during the first three years, but the fourth year is spent almost entirely in the study of electricity, theoretical and practical, and electrical engineering.

The laboratories are very well equipped with electrical apparatus, which closely resembles that described in previous articles. One of the essential differences in the equipment of this institution, as compared with that of others, is that a compound steam engine, of 30 h. p., is used in connection with the usual 8-h. p. gas engine. The steam engine is non-condensing and was built by the Maschinenfabrik, Augsburg. Its nominal speed is 60 revolutions per minute. The gas engine was manufactured by the Maschinenbau Gesellschaft zu München, and is of the Adams system.

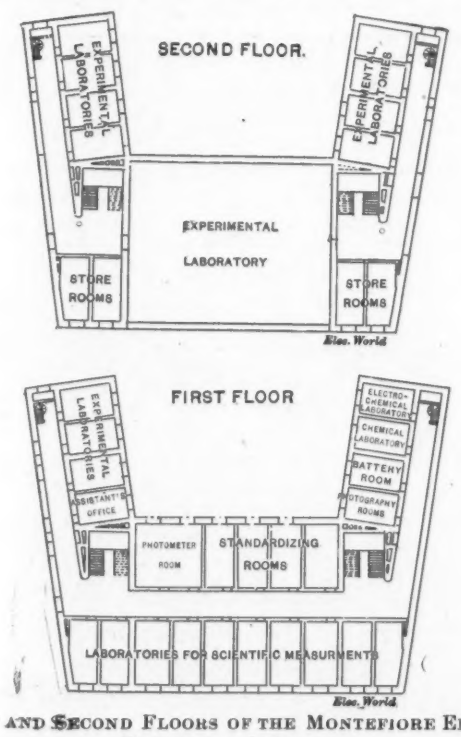
The photometric room in the electrical laboratory is the largest of any institution on the continent, measuring 25½ metres (about 80 feet) in length. It is very finely equipped with photometers designed by Bunsen and Weber, and several other standard instruments. The course of study in photometry is well laid out, and is taken up with special interest by a large number of students.

An alternating current dynamo forms a part of the equipment, which is the same Gramme alternator exhibited in Paris in 1878. The speed of the machine is 1,000 revolutions per minute, and furnishes a current of eight ampères, at a potential of 50 volts.

The electrical equipment of the laboratories is very complete, and includes dynamos, motors, accumulators, primary batteries, volt and ammeters, and other measuring instruments from the best electrical firms in Europe.

THE LIÉGE SCHOOL OF MINES AND ENGINEERING, AND THE MONTEFIORE ELECTRO-TECHNICAL INSTITUTE.

Liége, Belgium, is a busy, prosperous city, pleasantly situated on the banks of the Meuse, a fine broad stream, the two portions of the town being connected by five hand-



FIRST AND SECOND FLOORS OF THE MONTEFIORE ELECTRO-TECHNICAL INSTITUTE.

some bridges. It has a population of nearly 150,000, which, with that of the three principal towns of the province, Verviers, Huy and Spa, about 72,000 more, makes a total of 222,000 inhabitants. It is essentially an industrial district, and tall chimneys on all sides and the shafts of coal mines testify to the work going on in the many and varied industries for which the city is famous.

At Liége are established the Royal gun factory, the State cannon foundry, the State proof house, and for miles on both banks of the Meuse are extensive establishments for the manufacture and working of iron, steel, etc., of all descriptions.

Liége is, moreover, an important educational centre. It possesses a fine university (erected in 1817 and at present undergoing extensive alterations and improvements), attended by over 1,500 students. The building comprises lecture rooms, a library of over 200,000 volumes, academic collections, a natural history museum, and an excellent apparatus for instruction in physical science; and there are over 70 professors who lecture on the various subjects taught. In connection with the university are a school of medicine, an "Ecole des Arts et Manufactures," a school of mines, a special school for electrical engineering, a pharmaceutical institution, and a training school for teachers. A few years ago the Belgian government granted funds for the erection of new physiological, physical and chemical laboratories

The advantages offered by Liége from an educational point of view do not appear to be recognized in the United Kingdom; for while the youth of almost all the other European nations are fairly, and in some instances largely, represented at the Liége University, the British students rarely number more than five or six at a time, and sometimes not even that.

Liége, nevertheless, appears to offer peculiar advantages to the youthful Englishman completing his education, particularly in these days when the knowledge of foreign languages is becoming more and more essential to success

THE POLYTECHNICUM AT MUNCHEN.

in life. The French spoken in the district is the best in Belgium, and a knowledge of this most useful of modern languages may be acquired while the theoretical studies are being pursued at the university, or practical experience gained in one or the other of the large industrial establishments in the neighborhood. Moreover, the cosmopolitan nature of the students themselves makes it quite possible for the foreigner (who desires to acquire another language in addition to French), by the judicious selection of his companions, to perfect himself colloquially in whatever language he may have taken up the study of. The educational advantages of Liége are further enhanced by the possession of a fine conservatory of music and an "Académie des Beaux Arts," etc.

Prof. Kaufmann gives some very interesting data in reference to the School of Mines and the Electrical Institute. The School of Mines and Engineering, like nearly all the principal educational establishments in Belgium, was founded and is maintained by the government. It was in full working order in 1836, though certain courses were given at the university as early as 1824.

The heads of the school are the administrator-inspector of the university and the two inspectors, chosen from the staff of professors of the school. The council consists of six permanent and three temporary members. The permanent members are: 1. The director-general of mines. 2 The secretary-general of the Minister of Public Instruction. 3. Three inspectors of study. The temporary members are nominated by the king for the period of four years and are chosen as follows: A functionary from the staff of the government mining engineers and two functionaries belonging to the teaching staff of the school.

The organization of the school has been planned with the view of establishing, by practical work between the oral lessons and their applications, that concordance which cannot be supplied by the most energetic personal efforts.

Between the two extremes of an absolute liberty and a rigorous discipline, the school has adopted a policy of relative liberty, which, while all work is severely controlled, leaves just enough responsibility to the pupil for the development of that moral firmness of which he will have to give proof later on in life. Within, the lessons, graphic exercises, laboratory work and test examinations succeed in strict order; without, regular work is assured by frequent test examinations, which count in the yearly and final examinations.

The theoretical instruction is completed by the situation of the school in a mining and manufacturing district. Geological excursions, frequent visits to workshops and factories under the direction of the professors, descents into mines of the neighborhood, permit of the immediate application of the principles exposed in the lessons by the observation and discussion of facts. This permanent contact with the working world causes the difficulties of practice and the necessity of a rigorous discipline to be fully appreciated.

The English students who intend to study engineering at Liége have two courses open to them. 1. Legal diplomas. They may pass the entrance examination and study for a legal diploma, *i. e.*, a diploma which, in the case of Belgians, permits one to compete for a Belgian government

t. 2. Special diplomas. They may draw up a private programme and without passing the entrance examination follow certain lectures only and go through the practical work pertaining thereto. Diplomas attesting that they have passed with satisfaction or in honors in these subjects are granted by a special board of examiners.

There are three legal diplomas, and they confer on the holder the following titles: Mining Engineer, obtained after a two years' preparatory and a three years' technical course; Mechanical Engineer, obtained after a two years' preparatory and a two years' technical course; Engineer of Arts and Manufactures, obtained after a one year's preparatory and a three years' technical course.

Mining engineers who show sufficient knowledge of industrial and organic chemistry may obtain the diploma of Engineer of Arts and Manufactures. After a year's extra study they may obtain the diploma of Mechanical Engineer. Electrical engineers may also obtain, after a year's study, the diploma of Mechanical Engineer.

The Montefiore Electro-Technical Institute was founded in 1883 by Mr. Georges Montefiore Levi, member of the Belgian Senate. When it was founded there was no similar institution in any other country. In Germany there were a few polytechnic schools, Darmstadt, Stuttgart and Aix-la-Chapelle—which had departments for studying electricity. Their modest resources did not, however, permit them to give the necessary extension to practical work. Like attempts had been made in Italy. In England there was no institute for electro-technical studies. France possessed only a telegraph training college.

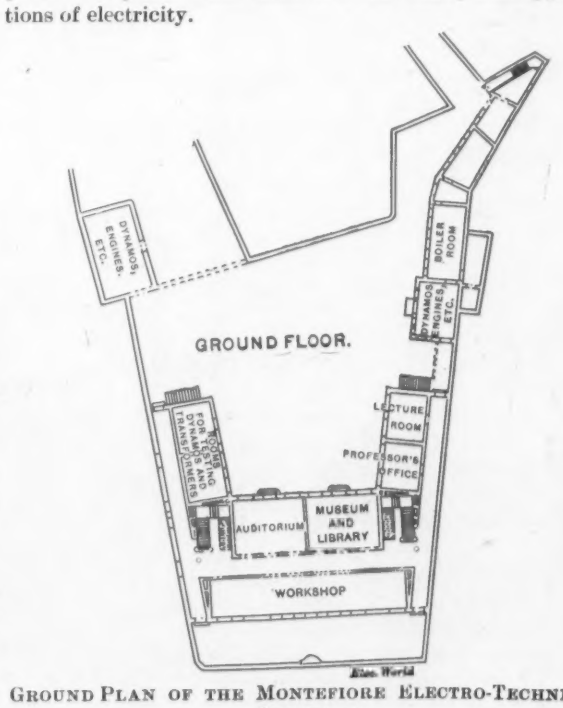
The object of the institute was to form electrical engineers by a course of theoretical and practical studies, destined to initiate the pupils in the science of electricity and its applications to industry. The studies are divided into three parts: 1. Theory of electricity and magnetism. 2. An electro-technical course. 3. Practical work in the workshop and laboratory (six hours daily in the year's course).

One of the characteristics of the institute is the development given to practical work. The programme is so arranged that the pupils may not only acquire the theoretical notions which are necessary to them, but also sufficient practical knowledge to enable them to be useful either in a telegraphic, telephonic or electrical works of any kind immediately on leaving the institute.

The accompanying cuts give an idea of the arrangements made to facilitate the carrying out of the above programme.

On the ground floor we find the lecture rooms, the directors' office, the museum, workshop, testing room for small dynamos and transformers, a hall for the trial of the more powerful dynamos, a pavilion with the service engines, and the boiler room.

The museum is provided with a very complete set of measuring apparatus for the use of students, and also a great number of models used in demonstrations. The library, which is open to students, comprises the greater part of the publications relative to the theory and applications of electricity.



GROUND PLAN OF THE MONTEFIORE ELECTRO-TECHNICAL INSTITUTE.

All the apparatus employed for working in wood and metal are to be found in the workshop—lathes, saws, forges, carpenter's benches. Each student has his own vise and tools. All the machines are moved by electric motors.

One of the proof rooms is for continuous and the other for alternating current dynamos. They have as motive power electric motors of 10 h. p., and are provided with dynamometers of transmission and absorption.

The dynamos, whose motive power is greater than 10 h. p., are tested in the engine room. In this room we also find a horizontal steam engine of 30 h. p. and an electric motor of 20 h. p., which can work together or independently.

To give students a clear idea of the distribution of electric energy, the engines used in lighting the institute and the electric motors in the latter have been brought together in a separate pavilion. A tubular boiler produces the steam consumed by the steam engines and the heating apparatus. The students may thus familiarize themselves with the

working of steam engines and generators and make trials of regularity, consumption, etc., of the above apparatus.

The laboratory of elementary measures is situated on the first floor; it is subdivided into a series of small rooms. This arrangement has the advantage of isolating the divers groups of students in such a manner that they are not in the way of one another. Besides these rooms there are a chemical laboratory and an electro-chemical laboratory, a room for the preparation of batteries and a photographic chamber. A photometric chamber provided with photometers of different systems, and measuring instrument ooms are also on the first floor. The latter are arranged for the graduation of measuring apparatus and comparison with the standards.

The second floor is reserved for researches made by the professor, the assistants, the more advanced pupils, and strangers who have obtained special permission from the director to pursue their investigations in the laboratory. Finally, and on the same floor, is an immense room for experiments requiring considerable space.

There are two classes of pupils: 1. Those who follow the year's course of electrical engineering only. 2. Those who follow the the two years' course comprising electrical engineering and other branches. To be admitted to the first of these sections one must hold a Belgian legal diploma as engineer or possess sufficient preliminary knowledge, i. e., a general knowledge of physics, chemistry, mechanics and mathematics up to and including differential and integral calculus.

Those who desire may study the year's course in two years. The first year they attend the workshop, follow the elementary part of the electrical course and study mathematics and physics privately. The second year they complete the study of electricity and finish the laboratory work. The holder of the diploma of Engineer will, at the end of a year, obtain a legal diploma as Electrical Engineer; others a special diploma.

To be admitted to the second of these divisions one must pass an examination in physics and mathematics, or have been through the two years' preparatory course (same as for other departments).

The courses begin about the 15th of October and continue to the end of June, and the examinations take place in the month of July. The examinations, graphical exercises, practical work and manipulations are carried on in the rooms, shops and laboratories destined for this purpose and are subject to fixed regulations. Open air work, mineralogical explorations, visits to industrial establishments, plans of machines, and generally all the means of a professional education which can be offered to students, of scientific excursions and visits to shops and mines, are made chiefly during the summer term, at such times as are chosen by the authorities of the school after consulting the professors. The regulations are so devised that the time passed in the school by the pupils amounts to about eight hours daily.

At the end of each year the pupils who desire to belong to the staff of government mining engineers are examined by a jury appointed by the Minister for Home Affairs; the others by a jury appointed by the Minister of Public Instruction. Except there be any special rule in the general programme the marks obtained during the year will count as a third at each yearly examination.

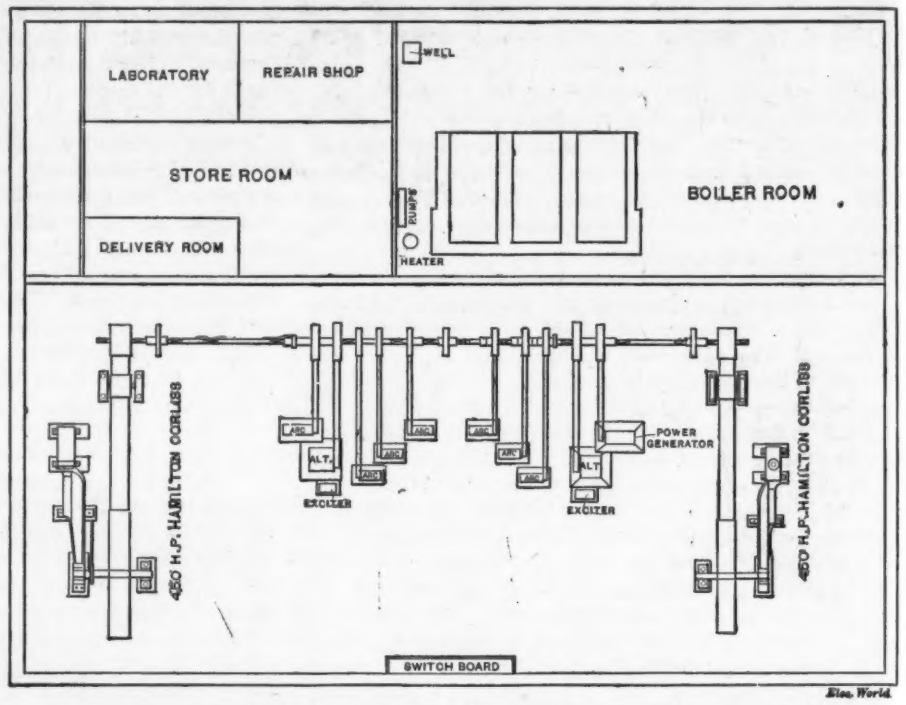
Pupils of the School of Mines not desirous of becoming government mining engineers, as also other engineering pupils, may obtain diplomas of capacity. These diplomas confer the title of Civil Mining Engineer, Engineer of Arts and Manufactures, Mechanical Engineer or Electrical Engineer.

The length of the ordinary course for civil mining engineers is five years; two of these are passed in the preparatory school. The course for Engineers of Arts and Manufactures extends over four years, one of which is passed in the preparatory school. The Mechanical and Electrical Engineer each follow a four years' course, two of which are passed in the preparatory school.

Civil Mining Engineers, Engineers of Arts and Manufactures and Mechanical Engineers may obtain the diploma of Electrical Engineer or a certificate of capacity after a year's study. The examinations are written and oral, the candidates being examined orally in the order determined by drawing lots.

Candidates who at an examination obtain 50 or 55 marks out of 100 pass with satisfaction; 68 marks out of 100 with distinction; 78 marks out of 100 with great distinction; 86 marks out of 100 with the greatest distinction.

The fees for examination are as follows: Admission to the preparatory school, 25 francs; for removal from one year to another, 40 francs; for a final examination, 50 francs. The fees to be paid by pupils of the school for all lectures and final examinations are fixed as follows: 200 francs for each year in the preparatory school, 100 francs for each year in the technical sections. The pupils pay besides 20 francs for practical work in chemistry, 20 francs for docimastic work, 20 francs for each year's drawing course, and 50 francs for laboratory work for electricity. Engineers who follow the year's course for the diploma for electricity pay 100 francs for lectures and laboratory work.



PLAN OF THE MUTUAL LIGHT AND POWER COMPANY'S PLANT.

A Southern Electric Plant.

BY A. F. M'KISSICK.

The Mutual Light and Power Company, of Montgomery, Ala., was organized during the fall of the preceding year, with Mr. W. F. Vandiver as president and Mr. C. G. Abercrombie as secretary and treasurer, the capital stock being $100,000. The contract for lighting the city of Montgomery was awarded this company in October, and immediately there was begun the erection of a plant which was designed to be in every particular a modern plant large enough for the present use of the city and with available space for future development. The station, 126 × 96 feet, of brick, was located in the northern portion of the city, convenient to railroads, and built so as to conform to insurance requirements.

Plans and specifications were furnished by the Mutual Light and Power Company, and the contract for the complete plant was let to the Brush Electric Company, of Cleveland, O. The plant was finished in January last, the work being very thoroughly performed by the Brush company's expert, Mr. I. J. Britton. While the installation is not a very large one, still much credit is due this company's officials for having erected a plant which is so thoroughly modern in every particular.

Steam Plant.—Three Heine safety boilers, connected together, with a capacity of 700 h. p., are used, working at a pressure of 120 pounds. The engines are Hamilton Corliss, single expansion, one 300 h. p. and one 450 h. p. Compound condensing engines would have been used, but sufficient water could not be obtained handily. Dean pumps and a Goubert feedwater heater complete the steam plant.

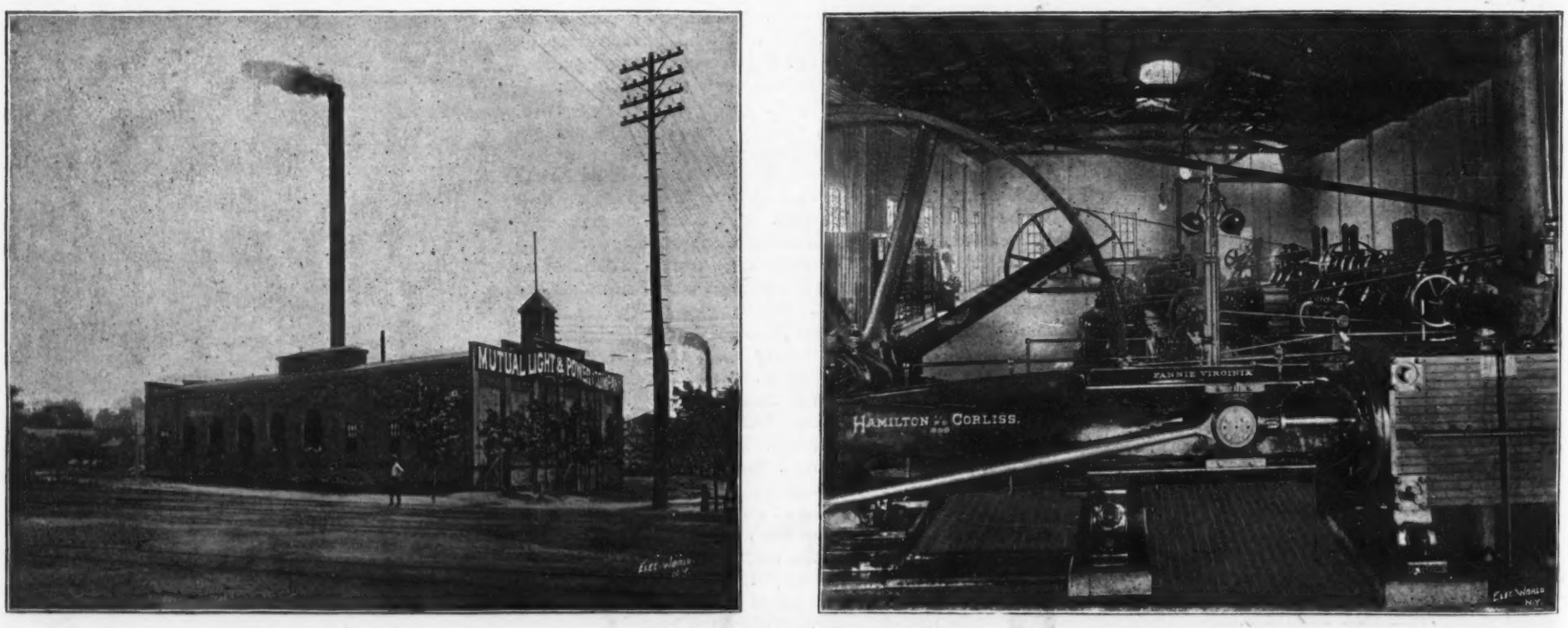
The supply of water is from two sources, a well and the city water-works. A large reserve tank is used in case these two sources should give out. The well is capable of supplying 50,000 gallons per day, and the capacity of the reserve tank, which is connected to the city water-works, is 50,000 gallons. A branch track from the railroad runs along the side of the boiler room, and the coal is unloaded direct, necessitating only one handling.

Electrical Plant.—The arc, incandescent and power generators are of the Brush types. The present capacity of the plant is 335 arcs, 2,400 incandescents and 70 h. p. for stationary motors. The switchboard is of marbleized slate, built especially for this station by the Brush Electric Company. With all the available space occupied, the capacity of the incandescent and power plants could be doubled. The Brush-Adams arc lamps and Thomson-Houston oil transformers are used throughout.

Belts and Shafting.—The belts, all double leather, were furnished by the Munson Belting Company; the shafting, clutches and pulleys by the Hill clutch works. The shafting has a clutch coupling at each end and also in the middle, thus allowing either engine to be belted to half or all the shafting. All the pulleys to which the dynamos are belted are also provided with clutches.

Line Construction.—The line wire was furnished by the New York Insulated Wire Company, and is known as their "competition line wire," over 100 miles of which was used. All poles are of painted cedar. All inside wiring is being done according to the rules of the Southeastern Tariff Association.

Since the completion of the plant there has been a steady demand for lights and motors. A 10-h. p. Brush motor has recently been installed in the "Montgomery Advertiser" Building, to be used for operating linotypes and presses, displacing a small engine and boiler. This company lights all the public buildings in the city, the railroad offices and yards, and the lighting of residences has been commenced.



EXTERIOR AND INTERIOR VIEWS OF THE MUTUAL LIGHT AND POWER COMPANY'S PLANT.

IN ELECTRICITY BUILDING AT THE WORLD'S FAIR.

Bell's Radiphone.

JUST now an interesting addition to the scientific curiosities in Electricity Building is Bell's Radiophone, by which conversation is transmitted through space on a ray of light, no wires or electricity being used in any portion of the apparatus. Most of our readers are probably familiar through descriptions with the photophone, by which a telephone is caused to respond to the variations in intensity of a light ray falling upon a selenium cell placed in a local electric circuit. Prof. Alexander Graham Bell succeeded in transmitting articulate speech in this way by making a beam of light, which a mirror reflects, vibrate, the vibrations being of the same kind as those produced by speaking through a membrane. He used a thin mica or glass plate as a diaphragm, which by being silvered served at the same time as a mirror. The reflected ray of light as it fell upon the selenium cell at the distant point varied in intensity in unison with the sound waves which caused the vibration of the diaphragm mirror. The varying intensity of the light produces in the selenium cell a corresponding variation in the resistance of the local circuit, and the varying current which results therefrom is translated into sound waves by the telephone, which correspond exactly with the sound waves which vibrated the diaphragm.

Bell's experiments and publications regarding the photophone stimulated further investigations, and it was found that the transmission of sound was possible without using selenium cells and galvanic batteries, and that non-luminous heat rays were capable of producing sound. The latter fact caused Mercadier to use the word "Radiophone" instead of "Photophone." A thin plate of any material serves as receiver in the radiophone, the sound produced by this plate being trasmitted by means of a tube to the ear. It was soon found that the receiver's plates were not made to vibrate transversely by the intermittent rays of light, but vibrated like ordinary sound plates. One and the same plate, for instance, is capable of giving the highest or deepest notes equally well; the breadth and thickness of the plate do not influence the pitch nor the sonorousness or timbre of the sound, except as it affects the intensity of sound; it was found to be immaterial of what substance the plates were made, but the slightest alteration in the surface made a considerable difference; scratched or oxidized surfaces increased the intensity of sound very much, while a silver glass plate gave no sound at all. As a rule, those plates proved most effective which absorbed the rays most strongly. Very good results were obtained by using plates the surfaces of which were covered with india ink, platinum black or soot; paper which in its ordinary condition gave no sound did so when the illuminated surface was covered with soot. The great sensitiveness of surfaces covered with soot caused Tainter to form the idea of substituting soot for the selenium in a selenium cell. Prof. Bell, however, pursued his investigations looking to obtaining sounds without the addition of a local circuit, and his latest production, that which is now about ready for exhibition in the Bell Telephone pavilion in Electricity Building, may be briefly described as follows:

In the northwest gallery, overhanging the main floor a few feet, there has been erected a small platform, upon which the sending apparatus is placed. This consists of a focusing arc lamp of the ordinary pattern, whose rays, rendered parallel by a lens, are reflected from a thin diaphragm mirror to the receiving instrument, about 80 or 90 feet away, at the north front of the Bell Telephone pavilion. The reflecting mirror is a disc of very thin glass, silvered on its reverse side, and held in a heavy brass frame by means of washers of ordinary blotting paper. Opening into the chamber in the rear of this mirror is an ordinary speaking tube, into which the sounds are uttered, causing the mirror to vibrate as would the diaphragm of a telephone transmitter. These rays, reflected in parallel lines, are received at the further end by a parabolic reflector, in the focus of which is placed a glass bulb containing a small portion of ordinary burnt cork. This bulb is blown into the end of a glass tube about a quarter of an inch in diameter and four inches long, the other end of which is open, and to which is attached an ordinary phonograph hearing tube, which extends into a small cabinet where the listener, removed from external noises, receives the message. The only adjustments required are that the rays be directed from the mirror in the gallery in an axial direction into the parabolic reflector, and that the bulb containing the burnt cork be brought to the focus of the parabolic mirror. This latter is accomplished by pushing the glass tube in or out until satisfactory results are obtained. Certainly nothing could be simpler than this, but although the instrument is of great scientific interest it has no apparent practical value.

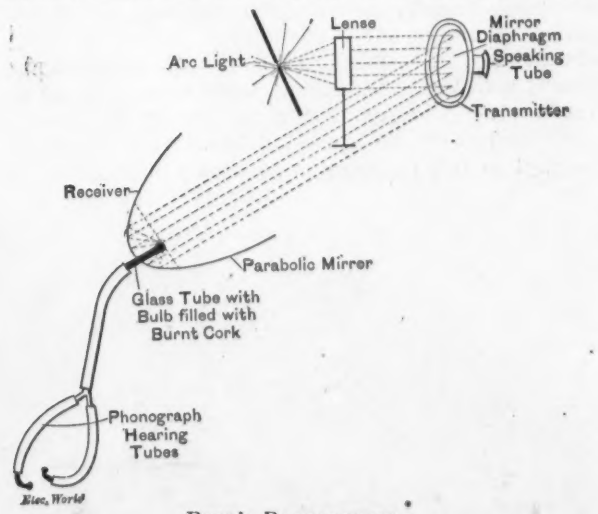
The transmitted words as heard through the hearing tubes lack sharpness of definition and have a somewhat muffled sound, which is probably due to the tube effects. The conversation can, however, be fairly understood if one knows beforehand about what is to be expected, but it would be difficult to follow an expression for which one was not prepared.

In Boston, under exceptionably favorable conditions, articulate speech was transmitted by means of the radiophone to a distance of about one-eighth of a mile, but this distance is beyond its range under usual conditions. The first experiments in the Electricity Building were over a distance of about double the present, but it was found that in order to get suitable results for the heterogeneous crowd at the World's Fair, even this distance had to be shortened.

In order to explain the philosophy of this phenomonon, whether it was due to light or heat rays, a number of experiments have been instituted. The rays were allowed to pass through a solution of iodine in carbon bisulphide, which has the property of absorbing the rays of light, but allowing heat rays to pass. It was found that the sounds were not influenced by inserting the solution. They disappeared, however, when a solution of alum, which absorbs the heat rays, but allows the light rays to pass, was substituted. From these and similar experiments it follows that the effect is not due to the light rays, but to the heat rays. Mercadier proved this by decomposing intermittent rays of light into their constituents by means of a prism; the spectrum thus received was examined by a receiver, the plate of which was covered up to a small slit. The different constituents of the intermittent light were examined in turns, and the same result followed. It must be remembered, however, that when light rays are absorbed as they are by lampblack or burnt cork, they are degraded into heat energy, so that, although we may remove from the transmitting pencil of light all the heat rays, we still may have satisfactory results with the burnt cork because the light rays which it receives are there transformed into heat. Professor Bell has given the following explanation:

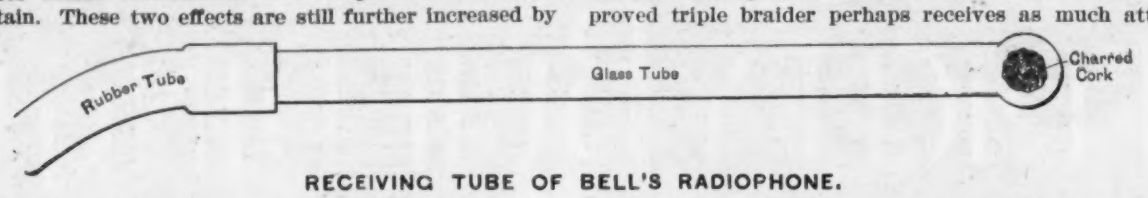
When the intermittent beam strikes upon the receiver the particles are alternately heated and cooled; when they are heated they expand, and consequently the intervals which are filled with air are diminished; when the light is intercepted, the particles are cooled and the spaces between them enlarged. Air is squeezed out from the interstices between the particles in the first case and drawn in in the latter; the enlarging of the intervals

A NIGHT SCENE IN THE MIDWAY PLAISANCE.



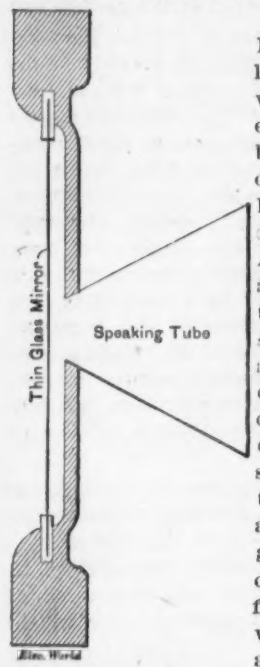
BELL'S RADIOPHONE.

causes rarefaction of the air in the cork particles, and the outer air rushes in; the contraction of the interstitial spaces causes condensation and escape of the air they contain. These two effects are still further increased by



RECEIVING TUBE OF BELL'S RADIOPHONE.

the heating and cooling of the air in the intervals alternately whereby the volumes are alternately increased and diminished. By these means alternate waves of compression and rarefaction are produced in the surrounding air, and it is to this that the sound which is emitted owes its existence.

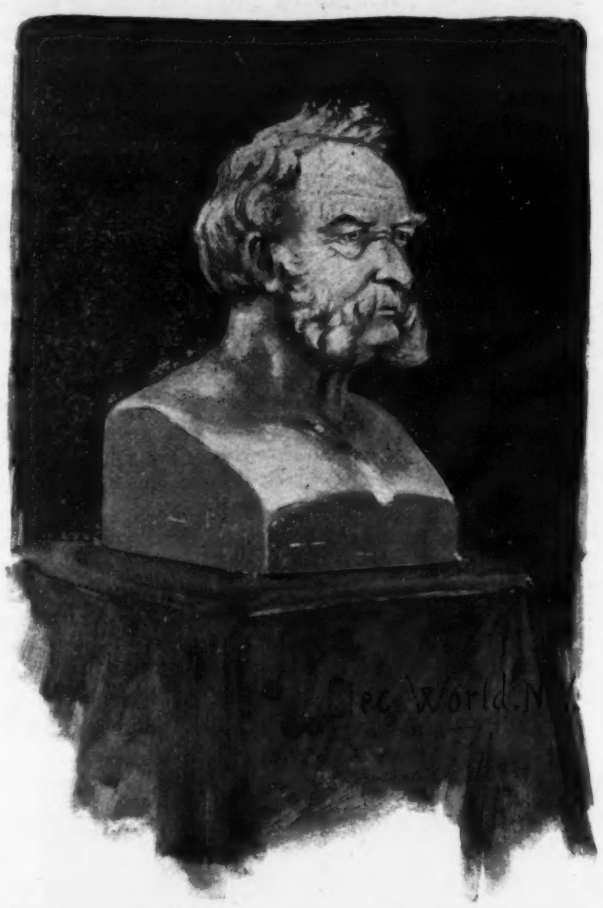


TRANSMITTING INSTRUMENT, BELL'S RADIOPHONE.

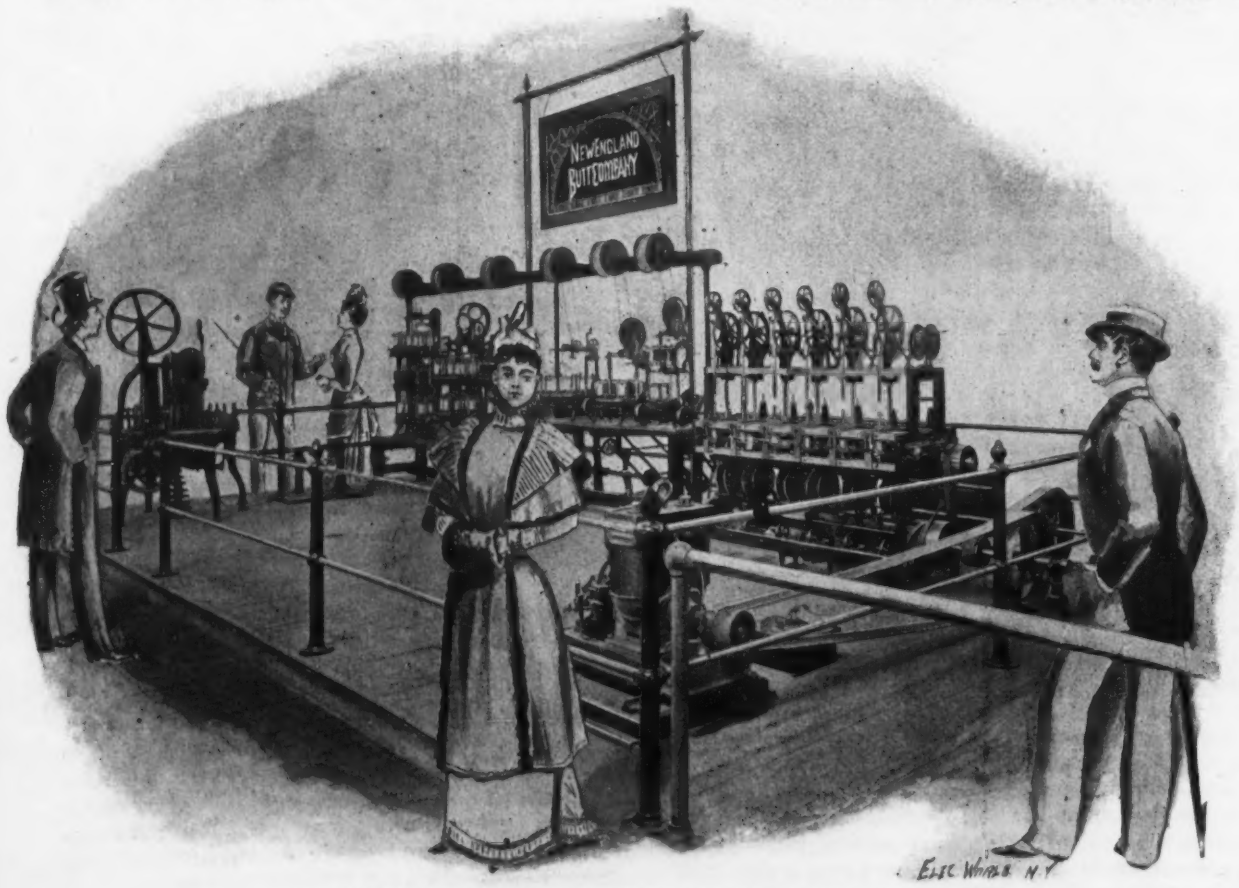
The radiophone at the World's Fair, which is the result of the latest investigations in this line, will probably be ready for public exhibition in a few days. It has been erected under the direction of Mr. W. L. Richards and Mr. Louis H. Beck, who have charge of the technical work in the American Bell Telephone exhibit, and it is through their courtesy that The Electrical World's representative has been able to make a private examination and report of its working at this date. Some of the difficulties that have been encountered in setting up the instruments are amusing. The distance between the transmitting and receiving instruments is so great that it has been difficult to communicate by word of mouth from the one to the other, which was almost essential in making adjustments. Telephonic communication was at once suggested, but Mr. Richards says he didn't dare employ this because of the suspicion it would cast upon the genuineness of the radiophone communication in the minds of the skeptical. In fact, he says that it has been impossible in many cases to convince their visitors that the conversation which they hear over the long distance telephone line connected with New York does not emanate from one of the adjoining rooms.

New England Butt Company's Exhibit.

An exceedingly interesting exhibit is found in the southeast gallery of the Electricity Building, and is that of the New England Butt Company, of Providence, R. I., of which Mr. H. N. Fenner is the popular treasurer and general manager. This exhibit, while having special attractions for wiremen, has a number of features of great interest to the general public. While the space assigned to this company is somewhat limited, it has made excellent use of it by showing as many of its machines of as great a variety as possible in actual operation. Here may be seen the single, double and triple machines, which are operated for exhibition purposes by an Edison motor. The general construction of these labor-saving devices is so well known that any detailed description is unnecessary. Their value is now become generally recognized, and both the quality and quantity of the work performed by them is far superior to that accomplished under older methods. The improved triple braider perhaps receives as much attention as any of the others. This machine is a large-gear braider, made in triple form, of size 16 by 20 by 24. These machines have been found to operate with great success for covering telephone and electric wires. While this piece of mechanism might appear somewhat complicated at first, it is compactly and strongly made, and built of the very best material and is not likely to get out of order. The six-spindle winder is perhaps the finest piece of mechanism in the exhibit, and for winding wires is said to have no equal. The double winder is a simple and inexpensive machine of great capacity.



BUST OF WERNER VON SIEMENS IN SIEMENS & HALSKE'S EXHIBIT.



AN INTERESTING COLLECTION OF BRAIDING MACHINES.

The International Electrical Congress.

As the date of the meeting of the International Electrical Congress, Aug. 21, approaches, preparations are being actively made. The question of railroad facilities is an important one, and Dr. Elisha Gray, president of the advisory council, has shown excellent judgment in appointing Mr. C. O. Baker, Jr., chairman of a transportation committee. Mr. Baker has been so successfully associated with the national electric light conventions in a similar capacity that his acceptance of this position is a sufficient guarantee that the best facilities for reaching Chicago will be offered. His headquarters will be at the office of the National Electric Light Association, 136 Liberty street, New York City, and he is now preparing a circular of information for the benefit of those in the East who expect to attend the congress.

The congress committee on invitations has issued nearly 950 individual invitations, of which about 600 are American and Canadian, including some of the foreign electricians attached to the World's Fair. General invitations to twelve foreign electrical and scientific societies with a membership in the neighborhood of 3,000 to 4,000 have also been issued, although it is not expected many of them will be accepted. The attendance at the congress is estimated at not less than 500.

Laboratory Notes.

BY LIEUT. F. JARVIS PATTEN.

NEW SINGLE-PHASE ALTERNATING MOTOR.

The experiments described in my former paper * readily suggest a motor for single-phase alternating currents which will be self-starting, and which when brought to synchronism will continue running at that speed with its normal rotary effort, and without any current from the source of supply in the moving part. This latter condition evidently implies a single-phase motor working without commutator rings or brushes and having the general characteristics of a rotary field or multiphase current machine with a closed induced circuit for the moving part. A commutator, or, strictly speaking, a current rectifier and brushes are needed for starting purposes only when synchronism is attained, which requires but a few seconds; the brushes are thrown off the rectifier, and at the same time the circuit on the moving part is closed upon itself.

The accompanying diagram shows the operative circuits of such a machine as it is being operated at my laboratory with comparatively low-frequency currents, but it is equally operative on currents of commercial frequencies by a multipolar system of connections, as has been amply demonstrated by experiment.

In the diagram, Fig. 3, a laminated iron ring has a double winding, one, G G, is the primary, while the other, g g, is the secondary of a closed circuit ring transformer.

Two diametrically opposite points, u v, of the primary are connected to the source of alternating current, A; the high tension circuit, if desirable, as this circuit need never be opened.

With the primary connected at the points u v to the

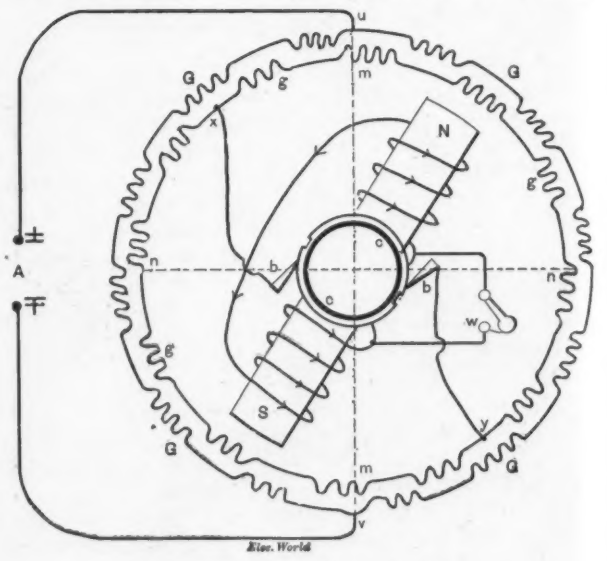


DIAGRAM OF PATTEN MOTOR.

source of alternating E. M. F., the diameter, m m, will be a line of maximum induction for the secondary circuit, g g, and the diameter, n n, at right angles thereto will be a line of minimum induction for the secondary. That is, if the secondary, g g, is closed by a circuit connected to m m, a maximum current will flow and if connected at n n practically no current will flow, and if an external circuit is connected at a pair of diametrically opposite points, x y, lying somewhere intermediate between m and n, then some current intermediate between zero and a possible maximum will flow in the secondary, and that in the primary will likewise be in some degree modified thereby.

The revolving part, N S, has a winding, the terminals of which are taken to the halves of the two-part commutator or rectifier c c, upon which bear the brushes, b b, and these are connected to the secondary as shown. Thus connected, the motor is self-starting and runs to synchronous speed in a few seconds. The circuit of N S is then closed upon itself by a switch, w, and the brushes are thrown off the rectifier. Arranged thus, we have an induction motor of the simplest form, the working circuit (primary, G G) connected only to the stationary winding of the machine. As very little current is required for starting; the points x y, where the secondary is connected, may be taken quite near to the line u u, and the sparking amounts to nothing.

*See THE ELECTRICAL WORLD of July 29, 1893.

Quartz Fibres and Rods: How to Make and How to Use Them.

BY EDWIN F. NORTHUP.

Theory and practice have shown that quartz fibres are not only much superior to silk fibres for all cases requiring the delicate suspension of a magnetic system, but that their unrivaled qualities of strength, permanence and lack of elastic fatigue render them for the above purpose quite ideal. The superior qualities of quartz as an insulator are also recognized, and their extensive use in the physical and electrical laboratory will warrant, it is believed, a detailed description of how they may be most readily made and handled. Several methods have already been described for the making of quartz threads by C. V. Bays and others, but details are not fully given, and a first attempt at making them after reading these descriptions will usually result in failure. The methods, moreover, heretofore described may be much improved.

Quartz is a silicon oxide Si_2O_3, crystallized, and when pure is perfectly colorless. When properly treated it is capable of being drawn out into threads of any desired fineness. The tensile strength of these fibres is almost equal to that of steel, and it is a rather curious fact that the strength, proportionally to cross section, is greater, the finer the fibre is drawn. This latter fact may be made use of, as will be described later on.

The writer, after much experimenting, arrived at two methods as best suited for drawing the fibres. These may be called the arrow and the reel methods, respectively.

Quartz will melt in the glassblower's flame, and a fine fibre is not destroyed by a Bunsen flame. The arc light is not suited for the purpose of making fibres, because there are fine particles flying about in the flame which mingle with the molten quartz and render the drawn fibres rotten. The most suitable source of heat is a pure oxyhydrogen flame. Oxygen and ordinary illuminating gas may be used, but the writer has been led to suspect that the carbon particles in the coal gas have, to some extent, the same effect in making the fibres rotten that the electric arc certainly has. A burner should be used in which the size of the flame may be regulated through a wide range. The kind of burner used in projection lanterns gives too fine a flame for first melting the quartz into a mass to draw the fibres from, though it is perfectly suitable after small rods of fused quartz have been obtained.

If a piece of the quartz crystal is placed in a hot flame it will fly to pieces in small bits, and it is, therefore, found to be almost impossible to fuse a piece of crystal in the flame by holding it in a pair of pliers. Consequently the quartz must first be prepared for fusing. This may be done in two ways. A piece the size of an egg or smaller may be wrapped up in a piece of asbestos cloth and placed in the centre of a hot furnace fire for a couple of hours. On removing it and allowing it to cool slowly it will be found that the crystal is full of fine cracks, giving it the appearance of frosted ice. If, now, a small piece of this is held in the oxyhydrogen flame it will fuse without flying to pieces. This fused piece can then be taken in a pair of pliers and one end fused. By touching other small pieces of quartz to the fused mass, its bulk may be increased at pleasure. When sufficiently large it may be fused in the centre and by taking hold of the two ends with two pairs of pliers the mass may be drawn out into a little rod about ⅛ inch thick and 2 to 3 inches long. The fibres can then be readily drawn from these rods, as will be described. A large flame will be required for making these rods.

Another method for preparing the quartz is to put some pieces in a shell graphite crucible and play the oxyhydrogen flame on them until the top surface is glazed with fused quartz. Having once gotten a small piece of the annealed quartz, this piece may be readily increased in size, as just described, by holding one side of it in the flame and pressing small pieces of the unfused quartz against the fused portion, where they will stick and melt. The preparing of the quartz rods of annealed quartz will probably present the greatest difficulty of any part of the process. In all this work the eyes should be protected either by colored glasses or a screen of smoked glass. I prefer the latter, about four inches square and mounted upon an adjustable stand.

The arrangements for drawing the fibres are made as follows. An arrow should be made of hard, tough wood about 6 inches long and 3-16 of an inch in diameter. It should have a small steel point securely fastened to one end, and on the other end should be fastened a strip of brass or clock spring about ⅛ inch wide and 2 inches long and projecting about one inch out behind the arrow. On this strip of metal a quartz rod, made as previously described, should be securely bound by wrapping it on with some fine wire. The quartz rod should project at least ⅜ of an inch beyond the end of the metal strip. The arrow is shot as follows: A fine rubber elastic is stretched at the end of a room from one side to the other and fastened to staples. Midway between the sides of the room three or four feet above the floor, and opposite the middle of the elastic cord is placed a soft pine board to serve as a target. The arrow is fastened about a quarter of an inch from its forward end to the middle of the elastic. Now, if the back end of the arrow is taken between the forefinger and thumb and carried back for a distance about equal to the middle of the room or the length of the elastic and then released it will fly straight, and its forward end will stick in the target every time. When this arrangement is completed the oxyhydrogen flame should be placed at a suitable distance from the target in a line normal to it. To shoot the fibre proceed as follows: Take a small quartz rod in a pair of pliers held in the right hand. Hold the arrow about one inch from the back end between the forefinger and thumb of the left hand. Bring the tip end of the rod of quartz fastened to the metal strip into the flame; also bring the tip end of the rod of quartz held in the pliers into the flame, so that the ends of the two pieces of quartz touch each other. When the two pieces of quartz are thoroughly fused into a thin continuous rod, suddenly release the arrow by parting the forefinger and thumb and at the same time push the piece of quartz held in the pliers forward out of the flame so that the quartz thread drawn out by the flight of the arrow will not be burned off.

You now have a thread extending from the target to the pliers held in the hand. The size of this thread will depend upon two conditions, namely, the speed with which the arrow flies and the softness of the fused portion of quartz from which the thread is drawn. To make fine fibres, therefore, the rubber should be very lively, and the mass of quartz fused small and very hot. A little practice will enable one to draw fibres of any desired thickness even up to rods 1-16 inch in diameter. To draw these heavy rods with the arrow, a large mass of quartz should be fused and then pushed forward out of the flame and allowed to partially cool before the arrow is released. Oftentimes the arrow will draw out a rod several feet long which will cool so as not to let the arrow reach the target. These rods have an excellent use, as will be shown later on, and one should learn how to make them.

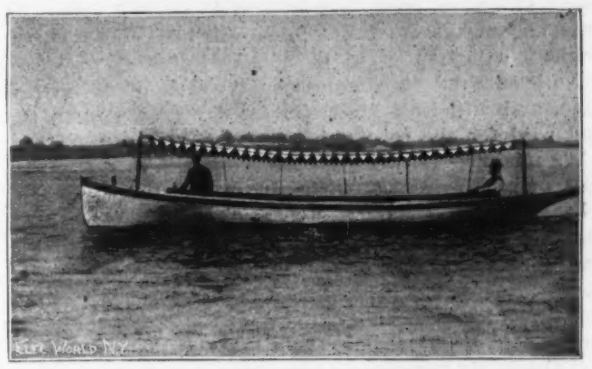
After the fibre is drawn, it may be most readily handled and preserved as follows: It is well to have the sides of the room covered with black cambric so that the fibres may be more readily seen against the dark background. They are best put up in long narrow boxes. These boxes should be 3 feet long, 4 inches wide and ¾ inch deep, and made of ¼-in. pine. The inside depth of the box should be about ½ inch, and the inside should be painted black. Two pieces of wood, each ¼ inch thick, 1 inch wide and in length equal to the width of the box, should be glued into the box at the extreme ends. These pieces of wood should be covered with a clean piece of white cardboard. Two other pieces of cardboard, half the width of the blocks of wood, should be fastened with two brads, only driven in a short distance, on the strips of wood at the extreme ends of the box. The fibres are then first mounted in the box and stretched lengthwise of the box from one piece of narrow cardboard strip to the others, as follows: After the arrow has flown, the fibre reaches from the pliers held in the right hand to the arrow fastened in the target. Now with the left hand fasten a small bit of beeswax upon the fibre near to the pliers. Then let an assistant place a small stick under the fibre about four feet from the pliers. Break off the fibre between the wax and the pliers, allowing it to fall with the wax on its end, so that it will hang straight down from the stick. Take the box in one hand and measure off on the fibre the distance from one strip of narrow cardboard in the box to the other, and pinch on the fibre another piece of wax. Now pinch on still another piece of wax two or three inches above the last. Then wet the finger and press the larger of the last two pieces of wax securely against one end of the narrow strip of cardboard. Then break off the fibre between the two upper pieces of wax, and so incline the box that the fibre will hang with its lower end nearly touching the narrow piece of cardboard at the lower end of the box. Next press the wax on the lower end of the fibre on the lower narrow strip of cardboard, thus securing the fibre in the box, tightly stretched from one end to the other. The assistant should then move his stick toward the target until a length of fibre hangs over the stick a little larger than the box. Fasten on the fibre two other pieces of wax at the proper distance from the lower end, fasten this fibre in the box as in the previous case, and so repeat the process until the entire fibre is used. It will be found convenient to shoot fibres about 15 feet long. After the box has been filled in this manner the fibres should be further secured in the box as follows: Make a composition wax of resin, sealing wax and beeswax. Make also a brass rod about six inches long and 3-16 of an inch in diameter. File one end to a point and fasten the other end in a wooden handle. Lay the box horizontal. The fibres will be stretched over the exposed part of the wide piece of cardboard, between the edge of the narrow strip and the inside edge of the wide strip. Heat the brass rod in a Bunsen flame, and then hold the point over a piece of the composition wax. A small, round drop of wax may thus be made to fall upon the fibre, fastening it securely to the broad strip of cardboard near its inside edge. When both ends of all the fibres have been secured in this manner, run a knife blade between the row of drops of composition wax and the row of dabs of beeswax. Pull out the brads holding down the narrow strips of cardboard, and remove it with the rough bits of beeswax. The fibres will thus be left tightly and neatly stretched from one end of the box to the other.

The fibres may always be seen in the box by holding it so that the sunlight will shine lengthwise of the fibres and be reflected into the eyes. After some practice two men working nine hours a day ought to be able to mount thus ten boxes of six fibres each. Fine fibres are much better to use in most every case, as will be explained further on, and consequently it will only pay to preserve those which are very fine. A fibre may be considered fine when, by looking at it against a dark background, prismatic colors are seen. The cover of the box should be fastened on with two brass hinges on the long edge of the box. The composition wax should be hard enough not to soften in hot weather and soft enough to melt at a lower temperature than sealing wax melts at.

(To be continued.)

The First Electric Launch on the Pacific Coast.

In the accompanying illustration the launch Electra is shown, which was the first craft propelled by electricity to be constructed on the Pacific Coast. Only one other electric launch has been used there and this was built in the East. The hull of the Electra was built by George Kneau and is 34 feet long. The motive power is furnished by 46 battery cells, manufactured by the River & Rail Battery Company, which supply current to a 5 h. p.



THE FIRST ELECTRIC LAUNCH ON THE PACIFIC COAST.

Sprague motor furnished by the General Electric Company, of San Francisco. The shaft is one inch in diameter and the propeller 14 inches. The revolutions have a normal speed of 500, but can be run as high as 700. The speed is 10 miles per hour. The cells are charged from a street railway circuit and will run for about 10 hours. The launch is owned by the Santa Cruz Electric Navigation company, of San Francisco.

The Care of Motors for Electric Street Railways.

BY JAMES B. CAHOON.

A careful investigation of the electric street railways in the United States would show that the majority of the roads in operation at the present time are running their cars without any systematic inspection and care; possibly 10 or 15 per cent. more have what they call by courtesy a system of inspection and care for their apparatus; another 10 per cent., which is a pretty liberal allowance, have electrical engineers at the head of their electrical department, and have a carefully organized system of inspection of not only the cars in operation, but of the line, of the power house, and, in fact, every detail of electrical equipment that is liable to deterioration or injury. To this latter class this article is not addressed, as the engineers quite likely know as much, if not more, than the writer about the system of inspection and the necessity therefor. To the other classes I would say that I not only hope for their kind indulgence, but that they will seriously think over the questions presented, and adopt as many of the suggestions offered as possible, because the whole idea is to lessen the cost of running the roads, particularly in the matter of repair bills.

In the first place let us consider for a moment what we have to deal with. In our ordinary electric car we have two 15-h. p. motors, with their various connections, and if we look at their situation we find it to be the very worst possible that could be selected in which to place machinery in motion, exposed as it is to heavy clouds of dust and dirt in the streets, with occasionally sticks and stones thrown in, and on rainy days and in the winter time to the throw of mud, slush or water from the wheels, and yet it is under such conditions as this that the electric motor is called upon to do its work satisfactorily and with a minimum amount of attention and care.

If we were to suggest to a steam engineer the placing of a fine steam engine to work under similar conditions and in a similar situation he might well be indignant, and think it a waste of material and money to require a good engine to do work under such bad conditions, yet in many respects the electric motor is quite similar to the steam engine, as both have moving parts to be lubricated, the motor having as its driving agent, in place of steam, an electric current under compara-

tively high pressure, requiring that certain parts shall be carefully insulated, any rupture of which will disable the motor for the time being. From this it may be seen that the motor is the more delicate of the two machines, and should, therefore, have more careful attention paid to it and a systematic course of inspection of all its parts made from time to time.

Some time ago I saw a motor which had been run on a road not having any system of inspection, and as a sample of the abuse one of these machines can stand this will afford an apt illustration.

The commutator was worn very badly and to a depth of a little over one-fourth inch below its normal surface, it having evidently been turned down once or twice before its present bringing in for repairs.

The armature pinion, which was of steel, had the teeth worn to a knife edge, and all of the teeth on one-half the pinion stripped. I did not see the gear. The wires on the surface of the armature, together with the band, were a total wreck. One side arm of the motor had been broken off 3½ inches from the armature bearing. The above was the effect, the cause lack of inspection which resulted in the above effect, from the fact that one axle bearing was worn completely through, and the axle had cut five-sixteenths inch into the iron of the motor, causing it to hang lop-sided and the armature pinion override the gear when a particularly heavy load happened to be thrown on the motor. The railway company endeavored to show that this accident was due entirely to the weakness of the motor, but when the general manager was shown the condition of the axle bearing, and how the axle had worn into the motor, and that the motor must have hung lop-sided and forced the pinion up on to the gear, thus bringing sufficient strain to break almost anything, and when he was shown the fracture which was clear and sharp, without a sign of flaw, he admitted that there might have been some carelessness on the part of the motorman, and withdrew his claim for damages, and in the end paid for the repairs.

We might assume, for the sake of argument, that the cost of repairs was $500; in this case it was probably more, yet were it only this it would pay the cost of an inspector for nearly a year, and this inspector would undoubtedly save many another motor in the course of his term of service. Yet this manager, when this very point was brought to his attention, not only by the example above, but also by pointing out to him that it was absolutely necessary if he was going to run the road in a satisfactory manner, either to himself or to the company who sold him the apparatus, that he must adopt some system of inspection of the motors which would prevent the recurrence of such accidents, has to-day only what might, by courtesy, be called a partial system of inspection. The motors are invariably in a filthy condition, and, apparently, very little care is being taken of any of the apparatus. I want to say right here, in behalf of this general manager, that when he was running a horse car road there was not a better one to be found in the country; the road paid handsome dividends and was managed in an economical manner, yet this man makes a failure of running an electric road, simply because he has the same ideas of economy in regard to electric cars that he had in regard to horse cars. He buys everything of the cheapest, pays his men the lowest wages of any road in his section of the country, and he sees to it that they work hard. His road is going to pieces, but he does not know it, and would feel insulted if anybody told him it was so.

Now, in regard to the care of motors in service, either it is neccessary to have a careful system of inspection or else the motors will run themselves. The writer believes that a system of inspection is absolutely necessary, and that such a system can be devised so that it will be far cheaper in the long run to pay an efficient corps of inspectors to look after the apparatus than it is to let the apparatus look after itself and pay heavy repair bills in the end. With this in view I would present the following system of inspection, with the hope that even if the management of roads do not adopt the idea in toto, they will at least adopt an efficient method of inspection of their apparatus. The plan recommended is as follows: There should be three classes of inspections, the Trip Inspection, the Daily Inspection and the Monthly Inspection.

In the first, or trip inspection, when a car reaches the end of its trip at the car barn, the conductor and motorman turn the car over to two inspectors, who should be on duty to receive each car as it comes in. These inspectors should go over the car carefully from one end to the other, see that the motors are all right, no bearings, field nor armature unduly heated, look at the bolts, check nuts and cotter pins and see that they have not worked loose; see that the connections are in good order, and that there is plenty of grease or oil in the cups, the commutators and yoke of the motor should be wiped off and freed from dust. Should anything be found the matter with the motors the car should be immediately run over the pit to have the trouble remedied and another car put into service.

This trip inspection should be brief and at the same time thorough. Two experienced men should not be over two or three minutes inspecting the car throughout.

The daily inspection should take place after the last trip at night. The car should be run over the pit and the motors thoroughly cleaned and dusted, particular attention being paid to the commutator. The carbon brushes should be removed and looked at to see if they are in proper condition for the day's service on the morrow, it being a good plan to strip back the copper on the brushes for at least one-fourth inch from the bearing edge which will tend materially to reduce the noise. All nuts, bolts, check nuts, cotter pins, gears, pinions and keys should be carefully tried or looked at to see that they are in good condition and in their proper place. The wires and wire connections should be carefully examined and seen to be sound and the insulation in good order. The controlling mechanism should be overhauled and tried, and if any burrs are found on the contact fingers of the controller or rheostat arm or reversing switch, these should be smoothed off and the whole put in good working order. The circuit should be followed out up to the trolley wheel, and this should be cleaned from dirt and its bearings attended to. Care should also be taken that the trolley wheel is in good contact with the fork, and the springs for holding the trolley up against the wire should be properly adjusted. Lastly, the brake mechanism should be gone over in a most careful manner, and every wearing part thoroughly inspected and placed in proper condition before the car should be allowed to leave the barn.

Particular attention is called to this point, because on the holding of the brake very often human life depends, and too much care cannot be exercised in attention to this oft neglected detail.

At the monthly inspection remove the armatures of the motors, remove the caps from the axle bearings, and drop the motor into the pit, giving it a thorough cleaning all over, being particular to remove all the oil or grease in the oil wells and clean the bearings. Examine the pinions and gears, see that no teeth show signs of cracking or excessive wear. Overhaul the fields and armatures and clean carefully, painting and repairing where necessary. It is always a good plan to keep both armature and fields thoroughly painted, as this prevents dust from working in beween the wires and short circuiting them. When it is found necessary to repair either an armature or field, they should be tagged with their individual number, the extent of the damage, date, cause of damage, if possible to ascertain; number of car, name of motorman, and blank should be left for the name of the man who repairs them at the time and blank spaces for the new car in which they are placed and the date.

In regard to the use of blank record sheets I do not think them necessary for trip inspections, as the conductor should not take out his car unless the inspector turns it over to him as O K.

Record should be made of the daily inspection and monthly inspection, an elaborate record not being necessary, merely one giving the number and condition of the motor, stating on it what part, if any, had to be repaired, date and name of inspector.

I know of some roads that go into the question of inspection even further than this, and give the cars a thorough overhauling every week, but it seems to me that if the above system is followed out faithfully, it can be done at a small expenditure of money, and will result in a material decrease of the very large repair bills, which, at present, are piling up against companies who are following no well-devised system of inspection.

The Electric Light and Power Transmission Plant at Pergina, Tyrol, Austria.

A rotary current installation which possesses some features of interest has been installed at Pergina, Austria, by the Maschinenfabrik Oerlikon. The water power for this plant is taken from a branch of the Tersina, which flows into the latter on the right bank at Serso. The brook comes from the Pine Valley, where it receives most of its water from springs. The usual average quantity of the water of the Rionero is 5.2 to 10.5 cu. ft. per sec., but in particularly dry times there is a minimum amount of 1.27 cu. ft. per sec. This circumstance was taken into consideration and the water power plant arranged accordingly.

The Ponte delle Piase is on the road to Pine, and 200 yards below this bridge the water supply is arranged for by a wall 23 ft. high, 50 ft. long, and 8 to 5 ft. thick, built across the valley. This dam is built down to a solid porphyritic rock foundation where it is firmly anchored at both ends as well as in the bed of the brook; it is arched to resist the water pressure and constructed of large blocks of porphyry and Portland cement. By this means a natural reservoir was built of about 7,800 cu. yds. capacity, which in the time of greatest drought will receive and hold all water flowing to it.

Thus it is possible to supply the necessary water for two 100-h. p. turbines. The fall from this dam to the turbine house is 328 ft., and in order to make the loss in pressure as small as possible, a pipe of 13¾ in. internal diameter was chosen, which can carry the 4 cu. ft. of water per second required for the 200 h. p. at the low velocity of 3.77 to 3.93 ft. per second.

Cast iron piping, with an internal clearance of 13¾ in., leads from the dam through a 5-ft. ditch with a continuous fall to the brink of the terrace, where a hydrostatic pressure of three atmospheres is obtained; from there on the duct is of welded flanged piping of steel plating laid over ground. This pipe line is 1,640 ft. long and by means of it a head of 492 ft. is obtained; like the rest it is 13¾ in. in diameter, built of 19-ft. lengths, and of a thickness varying with the pressure of the water of 0.14 to 0.28 in. An expansion piece is inserted at every second junction. The line is carried over roads on iron supports, and in one place crosses a brook valley on an iron trestle work 114 ft. long. On the pipe at the inflow to the reservoir a gate valve is inserted.

In the turbine house there is a blow-off and a safety valve, and in addition each turbine is furnished with a slide gate. At present there is a 100-h. p. turbine in place; it is of a partial Girard type with a horizontal shaft which by means of an elastic coupling is directly connected with the dynamo.

The construction, considering the mode of erection, is new for a turbine with horizontal axis in this respect, that the water flows in from the outside and is there distributed, thus necessitating a second inner guiding apparatus to carry the water down again. The turbine wheel is of aluminium bronze and weighs only 99 lbs. An exact test credits the wheel with 115 h. p. at 620 revolutions, which gives an efficiency of 74.2 per cent. The number of opened buckets is changed with the customary circular disc valve, which is made of phosphor bronze. The mode of speed regulation is also new. Where large variations in power with comparatively light moving parts are encountered, the indirect acting hydraulic governors have proved too slow, and besides they have the disadvantage of working unsatisfactorily with light loads on heavy duty motors often arranged for the full load. These evils are avoided in the regulating apparatus described below.

The turbine shaft carries a powerful angle pendulum and a spring regulator, which can be influenced by hand regulation as well as by rate of revolution, which operates through a system of levers a perfectly balanced rotary throttle device which has play in casing inserted in the influx pipe. The centrifugal governor has two weights of only 2.86 lbs. apiece. At 62 revolutions these, with few lever motions, suffice to compress an 880-lb. spiral spring; this device gives an energy of 35.2 lbs. at 2 per cent. variation of speed.

The other end of the turbine shaft carries a Raffard coupling, which connects the former with the shaft of the 100-h. p. rotary current dynamo. The latter has rotating cast steel field magnets with attached laminated wrought iron pole pieces, and a stationary armature. The small exciting dynamo is directly coupled with the shaft of the rotary current machine, which with 62 revolutions develops currents of 22 amperes per phase at 1,000 volts.

These currents pass to a switchboard where there is an ammeter for each phase, a compensating voltmeter for alternating current, one ammeter for the exciting current, a cut-out switch, lead safety fuses and automatic lightning arresters.

Then the currents reach the high potential lines, consisting of three 0.192-in. copper wires and one of 0.14-in. diameter. These are carried on 49-ft. wooden poles; and 3¼ ft. below the former is strung a telephone line with outgoing and return wires, which is crossed three times.

The distance from the central station to the centre of Pergina is 1.05 miles. At that place the high potential current is converted to 100 volts, and distributed for use as power and lighting.

Up to the present there are six transformer stations for light distribution: One of 35 kilowatts in the City Hall, one of 12 kilowatts in the church, one of 7.5 kilowatts in the insane asylum, one of 5 kilowatts in the primary station and two 20-kilowatt stations for power distribution.

The distributing network is over ground carried on iron supports; the lines for public and for private lighting are separate. The former consists of 90 25-c. p. incandescent lamps and two arc lamps connected with the 35-kilowatt transformers. The whole public illumination is operated from the City Hall. As yet there are only one 2-h. p., one 3-h. p., and two 12-h. p. motors. The total cost of the plant will be 125,000 florins ($56,625), including the cost of installation of 1,000 lamps, besides 18,000 florins ($8,154) paid for three mills which owned some water rights. The prices for light and power consumption are the following: 5-c. p. incandescent lamps per year, 2.50 florins ($1.13); 10-c. p. incandescent lamps per year, 5 florins ($2.26); 16-c. p. incandescent lamps per year, 8 florins ($3.62); 25-c. p. incandescent lamps per year, 12.50 florins ($5.66); with the assessment of 5 kreutzer ($0.023) per year per lamp for amortizement of the house installation undertaken at the expense of the community. For power the charges are 30 florins ($13.59) per year per h. p., and 5 florins ($2.27) for the interest on and amortizement of the power distributing transformer stations.

The growth of the plant is very good, so that soon a second 100-h.p. turbine and dynamo may be installed.

The turbine and plate steel piping was supplied by J. Ig. Ruesch, of Dornbirn, and the cast iron piping comes from the Halbergerhuette.

Notes on the Electric Arc, with Some Experiments on the Arc Under Pressure.

BY DR. LOUIS DUNCAN, A. J. ROWLAND AND R. I. TODD.

Twenty-five years ago Edlund, to account for some of the phenomena which accompany the production of the electric arc, supposed that there existed in it a constant counter electromotive force, the flow of the current being opposed by this and by the ohmic resistance of the column of heated air and carbon vapor forming the arc. This formula was,

$$E = a + b\,c\,l.$$

Where E is the P. D. at the terminals, a the counter E. M. F., b a constant, c the current and l the length of the arc.

That this formula is not correct may be seen by an inspection of table I., where the results are approximately represented by

$$E = a + \frac{b\ l}{c^{.7}}.$$

Other formulæ have been used or suggested: for example, S. P. Thompson suggests

$$E = a + \frac{b\,l}{c}$$

and Cross and Shepard employed

$$E = a\,c + b\,c\,l.$$

In each case the formula fits pretty closely the experiments on which it is based, but does not agree with experiments made under different conditions. In fact, almost any results may be obtained by modifying the size and composition of the carbons, and it is of the greatest importance to find what part of the phenomenon is constant and what is variable. The existence of the counter E. M. F. in the arc—supposing it does exist—has been accounted for in two ways: by the vaporization of the positive carbon, or by the thermo-electric effect of the carbon—carbon vapor couple which exists while the arc is burning. It seems to us that both of these must play a part in the phenomenon. As far as the vaporization of the carbon is concerned, this represents a certain amount of energy taken from the current; therefore there must correspond to it a fall of potential a such that $a\,c$ represents the energy necessary to vaporize the carbon. The amount of carbon vaporized may be calculated from the electro-chemical equivalent of carbon, while the value of a could be calculated if we knew the energy required to vaporize one gramme of carbon. Any attempt to discover a counter E. M. F. due to this cause by looking for a reverse effect on suddenly stopping the direct current must fail, as the E. M. F. stops simultaneously with the direct current. Such an E. M. F., if it exists, must remain constant as long as the temperature of volatilization of the carbon remains constant. If the temperature is raised—by pressure, for instance—this E. M. F. should increase. As far as the thermo-electric effect is concerned there is no reasonable doubt of its existence, since we have a composite circuit with two junctions at widely different temperatures. The temperature of the positive carbon is—under fixed conditions of pressure and composition of carbons—independent of the distance apart of the carbons and of the current, but the temperature of the negative carbon depends on both of these. It should be possible to detect this E. M. F. by shutting off the current and looking for a reverse effect. If we accept the vaporization theory entirely the counter E. M. F. would be independent of the length of arc and current; if we accept the thermo-electric theory we would look for a much more considerable lowering of the voltage in an alternating, as compared with a continuous, arc than really exists. Neither supposition will, by itself, explain the phenomena.

The total P. D. then should, for given conditions, be represented by

$$E = a + f(l)\,f(c) + b\,f'(l)\,f'(c).$$

Before giving the results of our experiments on the arc under pressure, we wish to call attention to one of the most remarkable of the phenomena exhibited by the arc; a phenomena which has often been observed, but for which we have seen no rational explanation.

By changing the current of the arc, using cored carbons ¼ inch in diameter, we obtained the following results:

TABLE I.

1 Atmosphere pressure.

Volts.	Amperes.	Apparent resistance.	Length in inches.
65.	3.1	21.	1/16
58.5	4.6	12.7	1/16
55.0	6.14	8.96	1/16
54.8	6.15	8.91	1/16
52.5	7.7	6.82	1/16
52.	8.	6.5	1/16
49.2	9.82	5.01	1/16
47.5	11.26	4.21	1/16
46.5	12.75	3.65	1/16

The only explanation that seems admissible is this: the effective E. M. F. is equal to E, the applied E. M. F. minus the constant counter E. M. F., a, due to the volatilization of the carbons, minus the variable counter E. M. F., a', due to thermo electric effects. The arc resistance would vary inversely as the current, provided, as might easily be the case, the section of the arc varied directly as the current.

We have then, $C = \dfrac{(E - a) - a'}{\dfrac{b\,l}{C}}$,

a' being a function of C. If now we increase C we decrease a', and also $\frac{b\,l}{C}$, and E will decrease until the equation holds again. For instance: suppose $a = 30$, $a' = 15$, $C = 10$, $b\,l = 5$, then

$$10 = \frac{E - 30 - 15}{\frac{5}{10}} \text{ and } E = 50.$$

Now suppose we increase C to 20, and a' changes to 10, then

$$20 = \frac{E - 30 - 10}{\frac{5}{20}} \text{ and } E = 45.$$

It is evident that whether E increases or decreases depends, first, upon the decrease of a' with the increase of current, and, second, upon the variation of the arc resistance with the current. Both of these will depend on the size and composition of the carbons and their distance apart. So it is very easy to see why different observers have obtained different results and deduced entirely different formulæ.

With solid Carré carbons ¼ inch in diameter the results were different, the P. D. remaining approximately constant under wide variations of current.

Arc Under Pressure.—The apparatus used consisted of an iron cylinder having stuffing boxes in the ends through which the rods holding the carbons passed. The upper rod had a rack and pinion for adjusting the arc and a scale for measuring its length. There was a pressure gauge on top. An air pump, connected with the cylinder, was run by an engine. There were two glass windows in the cylinder at right angles to one another, so the carbon could be observed. A water jacket around the cylinder kept it cool. A shunt dynamo which we had somewhat over-compounded supplied the current, which, in most of the experiments, was kept constant at six ampères. The arrangement is shown in Fig. 1.

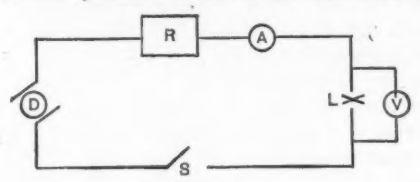


FIG. 1.

TABLE II.—TABLE OF AVERAGE VOLTS—CONSTANT CURRENT OF 6 AMPERES.

Length of arc in inches	Atmospheres pressure. Partial* vacuum.	1	2	4	6	8	10
1/16	†34 19	44.88	47.75	48.5	55.07	56.2	59.0
1/8	54.47	53.48	59.28	62.55	66.82	65.87	69.9
3/16	62.76	60.75	66.33	71.4	76.23	77.75	79.5
¼	71.81	66.78	73.31	79.9	.....	.....	.....

* About 1 inch of mercury.
† Probably hissing arc.

TABLE III.

Pressure in atmospheres.	Constant a. 1/16 and 1/8 lengths	1/16 and 3/16 lengths	1/16 and ¼ lengths
Vacuum	13.91	19.90	†21.65
1	36.28	36.94	†37.58
2	35.94	38.48	†39.43
4	34.5	36.2	†38.0
6	43.32	44.49	.....
8	46.53	45.4	.....
10	†48.1	48.5	.....

TABLE IV.

Pressure in atmospheres.	Constant a. 1/16 and 1/8 lengths	1/8 and 3/16 lengths	3/16 and ¼ lengths
Vacuum	13.91	37.89	25.61
1	36.28	38.94	42.66
2	35 94	45.18	45 36
4	34 50	44.85	45.90
6	43.32	48.0	.....
8	46.53	42.11	.....
10	48.1	50.7	.....

In determining zero readings on the scale a high resistance made of graphite was thrown in series with R. This was so proportioned that when the carbons were apart the reading on the voltmeter was about one-third that of the dynamo. When the carbons touched, the voltmeter fell to zero. Each reading was repeated a number of times. No readings could be obtained while the air in the cylinder was being disturbed.

The results are given by the curves and Table II. As C remained constant during the experiments, the value of a, considered as a constant, may be calculated from $E = a + b\,l\,f'(c)$, no matter what the function f' may be. Doing this we find the values of a given in Tables III. and IV. Leaving out values for the vacuum, which are low because of the very low reading taken for 1/16 inch, we see that by combining the values for 1/16 with ⅛ inch, 3/16 inch and ¼ inch, we get increasing values of a as the length increases, while, if we take 1/16 inch and ⅛ inch, then ⅛ and 3/16 and 3/16 and ¼, the increase is more rapid.

The tables show that a varies with l for all the pressures employed, for no function of l substituted for l in the formula will make a constant in the two tables. The absolute values of a, given in the tables, are probably not very accurate, as a small error in the voltages is considerably exaggerated in the results, especially in Table IV. So, in Table I., it is impossible to get any formula to fit the results. If we try to use $E = a + b\,l\,f(c)$, a seems to decrease somewhat as c increases, and the formula $E = a + \frac{b\,l}{c^{.7}}$ is only approximately correct. The increase of E with the increased pressure is shown in Figs. 2 and 3.

The behavior of the arc in partial vacuum is curious. The constant counter E. M. F. is probably lower and the positive carbon is not so hot, but the negative carbon seems to cool proportionately faster than the positive, so the variable E. M. F. increases.

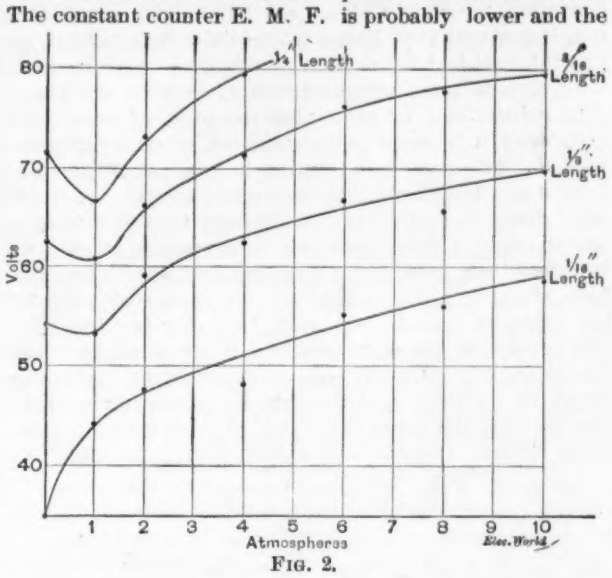


FIG. 2.

Looking at Tables II. and III. we will see that the fall of potential due to ohmic resistance does not seem to increase in any regular way with the pressure.

TABLE V.

Length of arc. Inches.	Atmospheres. 1	4
1/16	43.08	48.87
⅛	51.22	58.3
3/16	57.95	67.5
¼	65.64	...

TABLE VI.

Atmospheres.	Values of a' — 1/16 and ⅛ inch lengths.	1/16 and 3/16 inch lengths.	1/16 and ¼ inch lengths	1/16 and ⅛ inch lengths.	⅛ and 3/16 inch lengths.	3/16 and ¼ inch lengths.
1	31.94	35.64	35.56	34.94	37.76	34.88
4	39.41	39.55	.....	39.44	39.9	.

The very small values of a, however, shown in Table III., are due to the low reading at one-sixteenth inch, where there was in all probability a hissing arc. If we take the values from readings at ⅛ and 3/16 and ¼ we find them closer to the values for the other pressures.

To determine the effect of the surrounding gas, some experiments were tried in an atmosphere of carbon dioxide. The results are shown in Tables V. and VI. Although the values are a trifle lower than for air, they, in general, confirm the experiments of S. P. Thompson, who found that the arc was independent of the nature of the surrounding gas.

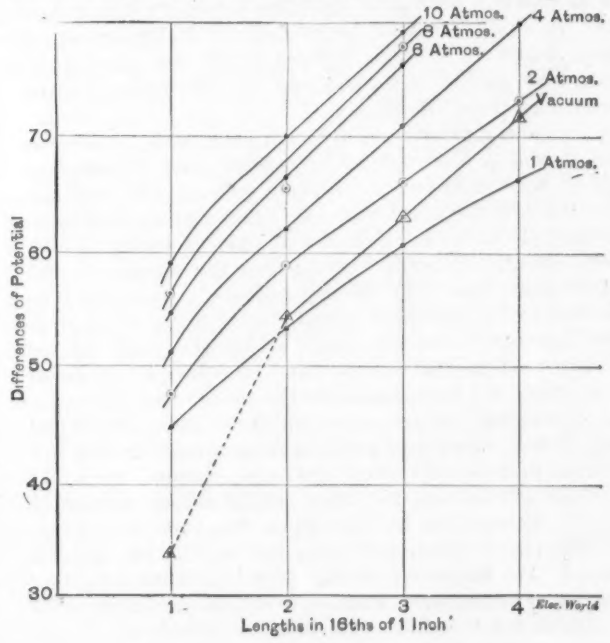


FIG. 3.

We conclude, then:

1. That the counter E. M. F. of the arc is made up of two parts, an E. M. F. due to the volatilization of the carbon, independent of the length of the arc, of the current and of the size of the carbons, but dependent on the pressure, and a variable thermo-electric E. M. F. depending on the length of arc, the current, the size of carbons and the pressure.

2. As the tendency of the arc is to increase in cross-section with the current, its resistance will decrease with the current.

3. The apparently anomalous decrease in E. M F. with increase of current is probably due to the decrease of the thermo-electric counter E. M. F. caused by the heating of the negative carbon, together with the decrease of ohmic resistance referred to above.

4. There is a constant increase of P. D. with pressure bove atmosphere for a given current and length of arc. Below one atmosphere the P. D. again increases.

5. The counter E. M. F. apparently increases with pressures above one atmosphere, while the ohmic resistance does not greatly change.

Practical Aspects of Low Frequency Electrical Resonance.—II.

BY M. I. PUPIN.

3. *On the Determination of the Pitch of an Electrical Circuit.*—If we wish to know the pitch of a musical instrument, say of a tuning fork, to choose a simple illustration, we simply give it an impulse, say a tap with the finger, and then listen to the vibrations, which, in general, will last for several minutes, and give us sufficient time to make up our minds as to what the vibrations sound like. In examining the pitch of an electrical circuit it is more convenient to adopt a different method. The reason is that, as a rule, electrical oscillations are, as pointed out in the example above, much more damped, so that the oscillations resulting from a single impulse would not last long enough to give us sufficient time to see what they look like, or to listen and hear what they sound like. The method suggested by the stroke of a violin bow over the string is preferable. The stroke of the bow produces a series of impulses which quickly succeed each other and maintain the string in uniform vibration. It is interesting now to observe that the same thing can be done with an electrical circuit. Consider the circuit A B C, Fig. 4. The

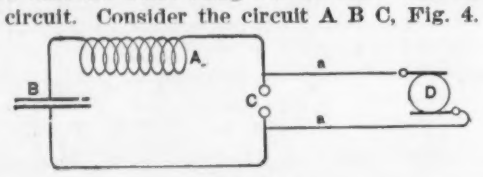


Fig. 4.

condenser B represents the tension on the violin string, coil A represents its inertia. The air-gap C stands for the point where the bow, by its stroke, excites the string. If you now wish a musician who plays with a one-sided stroke, use a high potential direct current generator D, and for an alternating stroke substitute an alternator. The discharges at the air-gap C succeeding each other quickly enough, and at proper intervals will maintain in the circuit A B C practically uniform electrical oscillations. This is one of Tesla's favorite circuits, and I have no doubt but that he will accomplish great things with it yet.*

Bring a few turns of wire of a telephone circuit into inductive influence of this circuit, and you will have in the telephone a musical note of exactly the same pitch as the pitch of the electrical oscillations in the circuit A B C. The note is not perfectly pure. It is marred by the noise of the spark discharge of the air-gap C. Neither is the note of the violin string pure; there is always more or less of the scraping noise of the bow. Just as it is necessary to keep the bow well rosined so as to give it a good grip upon the string, so it is necessary to apply a strong current of air or the action of some other of Tesla's devices upon the air-gap C, otherwise an arc is formed and the generator D loses its grip upon the circuit A B C .†

If we had a number of different coils with condensers like A and B alongside of each other, and arranged in such a way as to be able to place them at will, now the one and now the other, and now again a number of them in multiple under the action of the electrical bow which the generator D keeps moving over the air-gap C, and at the same time vary the capacities, we should be able to change the electrical vibrations of our system with that ease, precision and grace which the violin player displays, when with the one hand he guides his obedient bow, while the busy fingers of the other hand glide over the trembling strings, eliciting from them delightful notes which blend into pleasing harmonies. So with our system of properly tuned electrical circuits, we could produce harmonies, but they would be harmonies of silence, harmonious oscillations in the ether that affect neither eye, nor ear, nor taste, nor smell. But bring a part of the telephone circuit into inductive action of our harmonic system, and let a skilled experimentalist manipulate a properly constructed keyboard which controls the coils and condensers of the various circuits, and harmonics which before were silent as the grave, will now agitate the responsive diaphragm of the telephone and produce music that could be made to re-echo in every telephone in the United States.

But after all, such an arrangement when used for such a purpose would be a mere toy in comparison to the purpose for which our distinguished colleague, Mr. Tesla, employs it to convert high potential but small current electrical energy into low-potential big current energy, or vice versa, accompanied by all possible variations in the frequency of oscillations, was the purpose for which Mr. Tesla constructed the device. To a physicist who delights, not less than the engineer, in neat, simple devices for the accomplishment of big and brilliant effects this device of Tesla naturally appeals more than all his other ingenious inventions. Many a delightful hour have I spent in watching experiments on a circuit like the one in Fig. 4. The coil A consisted of a short, stout copper wire; the condenser B consisted of a battery of Leyden jars, which my distinguished teacher, Prof. Rood, of Columbia College, kindly lent me. The wires a a were thin copper wires connecting the air-gap C to the poles of an induction coil which is now in the hospital. It is a delightful sight to see the stout wire aglow under the powerful agitation of the rapid oscillations, whereas the thin wires a a adjoining them remained perfectly cool. Twist now the thick wire A into a few convolutions, say 10 or 12, and surround them by a few hundred turns of fine wire and you will have the now well known oscillatory transformer with which Mr. Tesla and Prof. Elihu Thomson produced some brilliant effects, a transformer that will give you any number of volts, especially if—and now I am going to touch a point which forms the central point of my discourse—especially if the thin wire coil contains capacity in series with it, so that the natural period of this circuit is the same as the period of the thick wire coil, that is, if the two circuits are in resonance.

4. *On Resonance.*—Here again I have borrowed a term employed in music. But a few simple considerations will show you that it is very natural that I should, for the phenomena of sound and those of oscillatory flow of electricity are governed by nearly the same laws. Very high frequency electrical oscillations would, in all probability, be identical with light, as first announced by the immortal Maxwell. It is, therefore, not surprising to find that low frequency electrical oscillations should resemble so much the other group of oscillatory phenomena, which, next to light, please our senses best, namely, the phenomena of sound, especially agreeable sound, that is, music.

To gain a clear conception of what is meant by electrical resonance consider the following simple mechanical analogon—I call it the "torsional pendulum:" I used it often with my students in discussing alternating current phenomena and they liked it very much. A heavy bar A (Fig. 5) is suspended on a stiff elastic wire B, which is attached to a plate C, whose weight may be neglected. This plate C slides in a groove, a a, which, in consequence of friction acts like a brake. Suppose now that

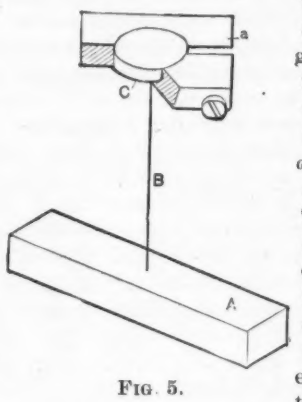


Fig. 5.

the friction between C and a a is such that when the angular velocity of C is ω the rate at which heat is generated by the friction between C and a a is equal to ω^2 R, where R is independent of the angular velocity. This torsional pendulum resembles then very much an electrical circuit having localized self-induction, capacity and ohmic resistance. The moment of inertia of A, the elasticity of B and the friction in C act exactly the same as the coefficient of self-induction of the coil, the capacity of the condenser and the ohmic resistance of the circuit. Let $\frac{1}{B}$ stand for the elastic capacity of the wire, that is, if the wire be twisted through an angle θ, then the moment of the elastic force which opposes this twisting is $\frac{\theta}{B}$. Let I stand for the moment of inertia of the weight A, then as long as the frictional resistance is within certain limits we shall have for the natural period of the pendulum

$$T = 2\pi\sqrt{I \times B}.$$

You see that this expression is exactly the same as the one which expresses the natural period of the circuit in terms of its coefficient of self-induction and capacity.

If this pendulum is set in motion by a single impulse it will oscillate with a constant period. The first elongation will be largest, and the successive elongations will be smaller and smaller, just as represented in Fig. 2, until the pendulum is reduced to rest again. This will happen when the energy of the impulse has been entirely dissipated into heat, which is the work done against frictional resistances in the break at C. The smaller this frictional resistance the longer will the pendulum swing in consequence of the impulse before it is reduced to rest. On the other hand, we can increase the resistance in C to such an extent as to make the swing a periodic or dead beat, as is, for instance, the case in the Weston voltmeters and ammeters.

Repeat the impulse at regular intervals, alternating them, the pendulum will keep on swinging; but you can easily see that if the intervals of the impulses are measured off in such a way that every time the pendulum passes through its position of equilibrium the impulse strikes it, and strikes it in the direction in which the pendulum is moving, then the amplitude of the swing will be much larger than if the intervals of the impulses are not measured off in such a way. In other words, when the period of the impulses is the same as the natural period of the pendulum, then the swing is largest. The impulses are said then to be in resonance with the pendulum.

The same effect will be produced, if for the impulses we substitute a periodically but gradually alternating force, say a simple harmonic force, having the same period as the natural period of the pendulum.

Such a force, when acting upon the torsional pendulum just described, will continually increase the amplitude of the swing, until the swing is so large that the work done during a swing against the frictional resistances is just eqr al to the work of the moving force during that time. From that point on the pendulum will swing with constant amplitude. It is evident, therefore, that the larger the amplitude of the moving force and the smaller the frictional resistances the larger will be the amplitude of the swing. But a large amplitude implies two things: First, a large torsional reaction in the suspension wire, and secondly, a large velocity whenever the pendulum passes through its position of equilibrium.

The bearing of this mechanical analogon upon the electric circuit having self-induction and capacity is very direct, as I shall presently point out. Let a simple harmonic E. M. F. E sin pt. act upon such a circuit. I shall presently consider a complex harmonic E. M. F., and also circuits possessing Foucault current losses, and losses due to magnetic and dielectric hysteresis. They will form the last and, in my opinion, the most important part of my discourse. A simple harmonic E. M. F. acting upon an elastic electrical circuit in which the only frictional losses are those due to ohmic resistance, will, when its period is the same as the natural period of the circuit, that is, when it is in resonance with the circuit, continually increase the amplitude of the electric displacement, that is, the amplitude of the condenser charge and therefore also of the current, until the work done against the ohmic resistance is exactly equal to the work of the impressed E. M. F. From this point on the amplitude of the current will remain constant and equal to the amplitude of the impressed E. M. F. divided by the ohmic resistance. Or, to state it in terms which are more generally employed: Capacity and self-induction neutralize each other when the circuit is in resonance with the impressed E. M. F.

It is evident, also, that in a resonant flow there can be no difference in phase between the current and the impressed E. M. F. Since, in this case, the current at any moment depends on the E. M. F. and the resistance, and on nothing else.

It is clear, however, that if losses due to Foucault currents, magnetic and dielectric hysteresis are present, then the current cannot be made equal to the ratio between the E. M. F. and the ohmic resistance by any combination of capacity and self-induction, although as a simple reflection will show, the difference in phase between the current and the E. M. F. may be reduced to zero in this case also,* in which case we should have no false current, as it is generally called. I shall presently discuss this point a little more fully.

(To be continued.)

* It must be observed, however, that Hertz, in 1887, produced his oscillations by a circuit of this identical form.

† The importance of blowing out the arc for the production of powerful oscillations seems to have been first recognized by H. Classen Wiedemann Annal. d. Physik undChemie, Band xixxx., p. 647, 1890.

Sir Francis Ronalds.

"Honor to the pioneers in the vast field of science!" says the "Daily News." Mr. John Sime has just published at the Chiswick Press, in pamphlet form, a very interesting memoir of Sir Francis Ronalds, with an autotype fac-simile of a portrait of this father of electric communication. Twenty years before Wheatstone and Cook and Morse had patented their improvements in the telegraph, indeed while the first two were respectively lads of 12 and 14 years of age, Ronalds had sent messages over eight miles of overhead wires of his own construction, and had laid and worked a serviceable underground line of telegraph of sufficient length to demonstrate the practicability of communication by telegraph between long distances. Details of his overhead telegraph wires were published by him in 1823. Ronalds' residence at Hammersmith, where these experiments were carried out, is the house now, and for long past, occupied by Mr. William Morris, the poet, who has caused a tablet to be placed on the wall bearing the inscription. "The first electric telegraph, eight miles long, was constructed here in 1816 by Sir Francis Ronalds, F. R. S., etc."—London Electrical Engineer.

Moonlight Table for August, 1893.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of August, under his modified form of moonlight schedule:

TABLE NO. 1. Standard Moonlight. Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	7:40 P. M.	1	10:30 P. M.	1	7:40 P. M.	1	10:30 P.M.
2	7:40	2	10:50	2	7:40	2	10:50
3	7:40	3	11:10	3	7:40	3	11:10
4	7:40	4	11:40	4	7:40	4	11:40
5	7:40	6	12:10 A. M.	5	7:40	6	12:10 A.M.
6	7:40	7	1:00	6	7:40	7	1:00
7	7:40	8	1:50	7	7:40	8	1:50
8	7:40	9	4:10	8	7:40	9	4:10
9	7:40	10	4:10	9	7:40	10	4:10
10	7:40	11	4:10	10	7:40	11	4:10
11	7:30	12	4:10	11	7:30	12	4:10
12	7:30	13	4:10	12	7:30	13	4:10
13	7:30	14	4:10	13	7:30	14	4:10
14	7:30	15	4:10	14	7:30	15	4:10
15	7:30	16	4:10	15	7:30	16	4:10
16	8:30	17	4:10	16	7:30	17	4:10
17	8:50	18	4:10	17	7:30	18	4:10
18	9:20	19	4:10	18	7:30	19	4:10
19	9:50	20	4:20	19	7:30	20	4:10
20	10:30	21	4:20	20	7:30	21	4:10
21	11:10	22	4:20	21	7:30	22	4:10
22		22		22	7:30	23	4:10
23	12:10 A. M.	23	4:20	23	7:30	23	12:00 M.
24	1:10	24	4:20	24	7:20	24	12:00
25	2:10	25	4:20	25	7:20	25	12:00
26	No light.	26	No light.	26	7:20	26	12:00
27	No light.	27	No light.	27	7:20	27	12:00
28	No light.	28	No light.	28	7:20	28	12:00
29	7:10 P. M.	29	8:30 P. M.	29	7:20	29	12:00
30	7:10	30	9:20	30	7:20	30	12:00
31	7:10	31	9:40	31	7:20	31	12:00

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

High-Pressure Experiments.—Mr. Swinton showed the following experiments at the Royal Society exhibition: A deep metal dish was filled with water and was connected to one of the spark terminals of an induction coil, the second terminal of which was connected to a stout wire, the end of which dipped vertically into the water in the middle of the dish; when a discharge was passed the water fell away from the central wire accompanied by much bubbling; when drawn just out of the water an octopus discharge was observed, a fact which was more marked when resin oil was substituted for water. Other interesting experiments shown at this exhibition, though not of an electrical nature, are mentioned in the Lond. "Elec. Rev.," July 14.

Gravitational and Electro-magnetic Analogy.—The London "Electrician," July 14, contains a paper by Mr. Heaviside on this subject, in which he bases his analogy on the supposition that gravitational energy may be located in its medium of propagation in the same way that electro-magnetic energy is located in the ether: and that the former propagation like the latter is an elastic displacement in a medium possessing a certain amount of inertia. The article is of a theoretical and speculative nature.

Relations Between the Directions of Current Magnetism and Motion.—Mr. Rimington, in the Lond. "Elec. Rev.," July 14, discusses the rules which have been published for remembering the relations between the directions of current magnetism and motion, and gives another which he thinks preferable. Imagine yourself turning a screw, as, for instance, a corkscrew, then if the thrust of the screw represents the direction of the current, the direction of the magnetic induction (that is, of the lines of the force) is that in which the screw is being turned; or if the direction of the turning of the screw represents the direction of the current in a closed circuit, the thrust of the screw will represent the direction of the magnetic induction; from this he induces a number of other rules for other cases. It should be remembered that the E. M. F. due to increasing the lines through a circuit acts in the contrary direction to that of the current which would cause these lines.

Conductivity of Solutions.—The Lond. "Elec. Rev," July 14, describes briefly some researches by Holland regarding the influence of small quantities of non-conducting liquids in modifying the conductivity of other liquids, the non-conducting substance possessing no solvent action on the salts. He concludes that the conductivity is diminished in direct proportion by the addition of a non-conductor; that the conductivity varies with the nature of the salt and the non-conductor; that the molecular conductivity may be expressed graphically by straight lines.

The Use of Flowing Mercury in Equalizers of Potential.—"L'Ind. Elec.," July 10, contains an abstract of an Academy paper on this subject by Mr. Villemontée.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring **H**.—Mr. Russel, in the London "Electrician," July 14, describes a simple method for measuring the horizontal strength of the earth's magnetism which, though crude, is said to give results sufficiently accurate for many purposes; a small compass needle is placed east or west of a long vertical wire carrying a current; the distance from the centre of the needle to the wire is varied until the resultant field is so feeble that the needle rests in any position; then if the current is A ampères and the distance from the needle to the wire is D (presumably in centimetres) then $H = A \div 5 \times D$ in C. G. S. units. He gives the theory and various modifications of the method. He also applies it to calculating the co-efficient of self-induction of a wire bent into a large, plain, closed curve; the author is not very clear in all of his statements. In an editorial discussion of this paper, it is suggested that an ordinary tangent galvanometer may be used for the same purpose. This is usually employed to measure the current for a given value of **H**, but by reversing this process, and by knowing the value of the current, **H** can readily be calculated. It is also pointed out that in Mr. Russel's method the vertical wire must be very long, compared with the distance to the needle. It is stated in this connection, that by bringing a small compass needle east or west of a vertical wire, at such a distance that the magnetic field is exactly neutralized, then the distance in centimetres will be practically equal to the current in ampères.

Measuring Magnetic Fields.—In some experiments by Dr. d'Arsonval in the medical application of electricity, he requires the reproduction of magnetic fields of identical intensity; in order to compare their strengths he places a mercury thermometer in a subsidiary coil in series with the main solenoid, the Foucault currents generated in the mercury by the alternating field raising the temperature, which is a measurement of the field strength provided the frequency is constant; with four Leyden jars the temperature rises to 150 degrees C. in a few seconds.

Adjustable Carbon Resistance.—The Lond. "Elec.," July 14, describes and illustrates two forms of carbon rheostats which, however, do not appear to possess any novel features: one of them contains a horizontal pile of 40 retort carbon plates 3½ inches square and ⅛ inch thick, the pressure being produced by a screw, as usual; the resistance may be varied from 25 ohms to $\frac{1}{25}$ ohm, and the rheostat will carry 100 ampères (whether this is the current when the resistance is the highest or the lowest is not stated: this is a most important point and is for some unaccountable reason usually omitted in giving data for carbon rheostats); for still lower resistances there is an intermediate contact plate in the middle of the pile. In another vertical form for small currents, discs of carbonized cloth are used, having a hole in the centre through which the screw passes; with 150 sheets about 1⅛ inches in diameter and 2½ inches high the resistance varied from 10 to $\frac{1}{10}$ ohm; by carbonizing the cloth to a less degree the resistance may be made higher.

Portable Apparatus for Measuring Insulation.—"L'Ind. Elec.," July 10, reprints a paper by Ducretet & Lejeune, describing an apparatus in which the galvanometer, the resistances and 80 dry cells, together with the necessary switches and keys, are all contained in one box; the constant of the galvanometer is 20 divisions for one volt and one megohm; while the apparatus may be very good it appears to contain no distinctively novel features.

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory of the Thomson (Brown) Non-Synchronous Alternating Current Motor.—In the figure published in the digest last week, page 84, under this heading there is an error: the point A should be situated slightly to the right of the intersection of the two lines, and an ordinate from the point M perpendicular to the line O A should have been drawn, this being the line referred to as B M.

Direct Transformation of Alternating Into Continuous Currents.—Mr. Pollak, in a paper before the French Academy of Sciences, reprinted in "L'Ind. Elec.," July 10, describes an apparatus which differs from the usual simple commutator or redresser, in that the resulting pulsating direct current never reaches zero in its pulsations, as it never falls below a certain minimum value, which can be regulated as desired. It may be applied, for instance, to charging accumulators in which the voltage of this pulsating current should never fall below that of the accumulators in order that they do not discharge; to accomplish this the usual commutator for redressing alternating currents is made of segments which are wedge shaped, the points all being in the same direction; the brushes are moved parallel to the axis in one direction or the other until such a point is reached that the voltage of the redressed current is exactly equal to the counter voltage of the accumulators at the same moment of breaking the current; all sparking is thereby avoided; the commutator is rotated by a small alternating current motor, the only work it has to do being to overcome the friction of the brushes.

Shielding a Dynamo.—According to the Lond. "Elec. Rev.," July 14, experiments were made recently to determine whether a dynamo can be magnetically screened to a sufficient extent to enable it to be used at the Greenwich Observatory for electric lighting, without interfering with the delicate magnetic measurements made at that place. From the results it appears that the shielding will so greatly reduce the disturbing effect as to make it practically insensible.

ARC AND INCANDESCENT LIGHTS.

Incandescent Lights.—In the continuation of Mr. Ram's article (see Digest last week) in the London "Electrician," July 14, he describes in considerable detail, accompanied by much valuable practical data and instructions, the Swan process for parchmentizing cotton thread by sulphuric acid, which he claims remains to this day one of the best, if not the best method; the description is accompanied by a number of cuts, showing the apparatus used; the article is of a thoroughly practical nature, and shows considerable experience in lamp manufacture on the part of the author.

Arc Lights Versus Gas Incandescent Lights.—The London "Electrician," July 14, reprints in abstract a translation, accompanied by a large number of cuts, of the article on this heading mentioned in the Digest, July 1.

RAILWAYS.

Cars for the City & South London Railway.—The Lond. "Elec. Eng.," July 14, gives two good, large illustrations, one an interior and one an exterior view, together with some data, of the cars used on this underground electric road; as already described in these columns, the cars nearly fill the circular cross section of the tunnel, the seats are longitudinal, and the entrances are at the ends from platforms.

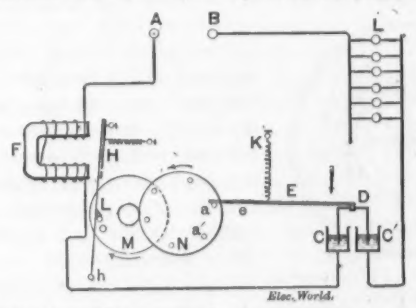
INSTALLATIONS, CENTRAL STATIONS, SYSTEMS, ETC.

Three-Phase Installation in Dresden, Germany.—Mr. Ulbricht, in the "Elec. Zeit.," July 14, describes briefly some of the features of this novel installation, comprising from 1,200 to 1,300 h. p., and in which, as has already been stated in these columns, three-phase currents are used; the installation is intended to supply light and power to all the railway stations of that city; the voltage of the generators, 115 volts, is raised by means of transformers to 3,000 volts, at which it is distributed to the various places of consumption, the mean distance being 1.2 miles, and the maximum 3.6 miles; the three-phase machines are coupled to common bus bars; the number of alternations is 100, that is, the frequency is 50; there is no connection with the earth from any part of the system, not even from the neutral point; there will be 80 arc lamps of 200 to 840 watts each, 3,600 incandescent lamps, and a large number of motors amounting to a total of 350 h. p. As is well known, the difficulty in this system is found in the balancing of the consumption on the three circuits: if they are not balanced when used for lighting, it has been found very difficult to regulate the voltages. This gave rise to a suggestion that the lighting might be done by means of an ordinary alternating current, while for the motors an additional independent current would be used whose phase differed from the other. It was also suggested that good results were obtained by using a two-phase system with a common return, in which case the regulation of the lamp circuits can easily be effected. Experiments were made with a 50-h. p. three-phase machine, with the circuits equally loaded, and it was found that the motors were equally efficient, even with considerable differences in the uniformity of the phases and voltages of the three circuits. But with two-phase motors it was found that there was a decrease in the torque when the two circuits were not balanced. It was therefore concluded that all the lamps could be run on only one of the three circuits, while the motors were run from all three circuits alike; it was found that in a seven-hour run the generators increased in temperature by the same amount when the circuits were symmetrically loaded, or when one circuit was loaded to 70 degrees of the full amount, while the other two were open. The lines are to be aerial; below them is to be a sort of net connected to the earth, which, in case of rupture of one of the lines, connects it to the earth; the loss in the high tension line is to be three degrees, and the amount of copper 88,000 pounds; for the lighting circuits special transformers are to be used, connected to only two of the wires, while for the motor circuits three-phase transformers are to be used; it would be possible also to use only three-phase transformers, running all the lighting circuits from only two of the wires; experiments have shown that within certain limits such a system is quite permissible, but when motors of appreciable output are to be used it will be preferable to have independent transformers for them in order that the light may be as steady as possible.

Three Phase Plant at Pergina.—"L'Ind. Elec.," July 10, gives a short description of this station in Hungary, including an illustration, though not a very good one, of the 100-h. p. generator; at 62 revolutions it generates 22 ampères per circuit, at 1,000 volts, which is reduced at the centre of the city, about one mile distant, to 100 volts; the station is described in another column.

Gas Engines in Central Stations.—The article from "L'Ind. Elec.," mentioned in the Digest, April 22, is translated and reprinted in the Lond "Elec. Rev.," July 14.

Automatic Maximum Current Interrupter.—In some central stations abroad the charge for current is based on a condition that no more than a certain number of lamps can be run simultaneously by a consumer without, however, limiting the number of lamps which he can install, or, in other words, the consumer can wire for as many lamps as he likes, but cannot burn more than a limited number at one time; this relieves the station from the necessity of being prepared to supply current for all the lamps at one time. The objection to this system is, that it is difficult to control the maximum consumption at the consumer's end, the apparatus generally used admitting of fraud, while fuses, or magnetic cut-outs, are objectionable. To overcome these objections an apparatus has been devised by Mr. Martin, shown in the adjoining cut, and described more in detail in "L'Ind. Elec.," July 10. It consists essentially of a magnet F in series with the lamps L, a mercury cut-out D, and a train of wheels M N driven by a clock spring; under ordinary circumstances the wheels are arrested by the armature H, but should the current become greater than the maximum allowed, the armature H will be attracted, will release the train of wheels, which in turn operates the cut-out; the cut-out will make and break the circuit intermittently as long as the current is too great, thereby notifying the consumer and, at the same time, making the light unbearable, owing to its intermittency; as soon, however, as the additional lamps are cut out so as to reduce the current to or below the maximum, the other lamps will again burn properly. The article contains three additional illustrations, showing the construction of the apparatus. One objection to this is, that should the clock work run down the switch will be left closed, and the apparatus is therefore inoperative; to avoid this a weight is arranged on the wheels so that when the clock work has run down the switch is held open by this weight; the clock work is capable of making 7,700 interruptions and need therefore be rewound but very seldom; the apparatus has been in actual use, and has been found to be very satisfactory.



AUTOMATIC MAXIMUM CURRENT INTERRUPTER.

Mechanical Cut-Out.—The Lond. "Elec. Rev.," July 14

illustrates and describes briefly a new magnetic cut-out; one of the chief features is that the sensitive ammeter does not work the heavy switch directly, but releases a comparatively small spring, which in turn releases a powerful mainspring, thereby breaking the circuit suddenly; it can be set again by means of a small lever projecting through the case, the case itself being locked; unless the cause of the excessive current has been first removed the switch will not allow the contact to be maintained. The results of a test made in Munich appears to be very favorable; in an instrument for about 7 ampères the variation of the cut-out was never more than .06 ampère; there were no cases in which it failed to act.

Rheostats for Feeders.—Mr. Claude, in "L'Ind. Elec.," July 14, discusses the subject of the calculation of rheostats for controlling the voltage in the feeders, showing that in calculating the resistance, as it is usually done, so that each step corresponds to a constant increment in the current strength, the regulation becomes very close for large currents, but quite insufficient for small currents. He gives the curves for a certain case, showing that the variation between 0 and 10 ampères is as great as 20 volts, while for the same variation of 10 ampères near the maximum value of the current it is exceedingly small. He thus shows that the usual method is a very poor one, as the regulation becomes quite insufficient when few lamps are running on that feeder, greatly to the detriment of those lamps; as the time during which few lamps are running corresponds to the greater portion of the 24 hours it is of considerable importance to regulate more closely for few lamps. He then shows that the proper method is to calculate the successive steps of the resistance coils in such a way that the possible maximum variation in the voltage is the same for every step; or, in other words, instead of having one step for each constant increment in the current, he suggests having a step for a constant decrement in the voltage, thereby obtaining the same regulation of the voltage throughout the whole output; the variation in the regulation in both cases is shown by means of diagrams; he explains in detail the methods of calculating the resistances in both cases; besides the feature of regulation, there is a gain in the weight of the metal employed; the loss in watts is the same in both.

Compensator.—The Lond. "Elec. Eng.," July 14, contains an illustration, though a not very good one, of a new compensator for keeping the pressure constant at the distant ends of the feeders in a low pressure three-wire system, by regenerating the volts lost in the feeders. It is designed by Mr. Sayers according to the principles enunciated in his recent paper (see Digest June 10, 17, and July 1). It is placed in the engine room, the current of the feeders passing through it, the potential being raised automatically by the required amount; the compensator consists of two series characteristic dynamos mounted on the same shaft and driven directly by a constant speed motor; the current for each feeder produces a magnetic flux proportional to the current strength, which reacts on the armature, generating an additional pressure proportional to the current passing; to compensate for the drop of pressure in the neutral wire this current is led around the respective "keepers" (field magnets) in such a manner as to compensate exactly for the loss.

WIRES, WIRING AND CONDUITS.

Submarine Telephone Cable.—The Lond. "Elec. Rev.," July 14, contains a short description of a new telephone cable made by Felten & Guilleaume. The cross section is shown in the adjoining cut. A group of four conductors, insulated from each other by means of a paper frame, is covered with a lead tube which in turn is covered with a double layer of gutta-percha. The armor is composed of very strong interlocking iron or steel wires; the insulation, therefore, is obtained by air and paper, and the watertightness by the gutta-percha and the lead; the sheathing takes up any pressure to which the cable may be subjected, thus rendering it incompressible, which is an important factor considering that the cable is hollow (the hydraulic pressure, however, will be taken up by the sheathing only in case the water cannot penetrate the interstices between the sheathing and the gutta-percha, that is, only as long as the envelope around the outside of the sheathing remains waterproof).

Submarine Telephone Cable.

Mains and Methods of Laying.—The Lond. "Elec. Eng.," July 14, reprints a paper on this subject by Mr. Biggs; the first part is intended for those who are not acquainted with the systems, and the second part gives a description at some length, accompanied by 19 good illustrations, of the Crompton bare wire system at Hove, of the system of drawing insulated wires through conduits, and of the protected wire system; in the former, bare wires are stretched in conduits on insulating supports, a system also used in London and Paris; the complete specifications are given for this system in the city of Hove, together with prices for laying; also the costs of laying in the second system.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrophone.—An article in "Ind. and Iron," July 14, states that the electrophone which has been in use in Paris for more than four years under the name of the theatrephone, is now to be introduced into London; the number of subscribers in Paris is at present over 1,500, and is increasing rapidly (the electrophone is simply a telephone which is connected to receivers placed in the theatres and opera houses for transmitting music and dialogues); the receivers will be installed in public places like hotels, restaurants, etc., where, upon payment of a small fee, one will be able to listen to a portion of the entertainment at the theatres for a period of five or ten minutes; specially constructed transmitters are placed on the stage of the theatres immediately in front of the footlights and are connected to the central station, where they are connected to the various subscribers; during an intermission at one theatre the receivers are connected with another theatre; connections are already made with a large number of the London theatres and the result has been found to be entirely satisfactory, both for music and speaking; a double metallic circuit is used so that each listener hears from four wires (presumably leading from two microphones on different parts of the stage). In addition to the different places of amusement it is intended to make connections with the law courts, and also, possibly, with the House of Commons; it is also contemplated attaching an intelligence bureau to the central exchange, where commissions of any kind will be carried for subscribers for a small fee. The company intends to apply its system of connections with theatres and churches to the principal hospitals free of charge, beyond that of the cost of installation.

Telephones in Glasgow and Stockholm.—In a report to the city of Glasgow, reprinted in abstract in the Lond. "Elec. Eng.," July 14, it is stated that in Stockholm the charge is only about $35 per annum, which covers free conversation within a range of 40 miles, the service being a very superior one (probably the best in any city). There is one subscriber to every 28 inhabitants, while in Glasgow there is only one for every 280. For cheap and efficient service it is plain that two conditions must be fulfilled: first, a twin wire system, together with the most modern appliances; and second, the strictest economy in the expenditure of capital. The English Post Office declines to connect any but twin wires with the new system of trunk wires which it is erecting throughout the country. Reliable estimates in detail show that for a capital of about $75 per subscriber the latest and best system can be laid in Glasgow, and a thoroughly efficient service can be given at a charge of only $25 per subscriber, or possibly even less.

Telegraphic Communication in the West Indies.—The serial by Dr. Anderson under this heading is concluded in the Lond. "Elec. Rev.," July 14. It is of commercial rather than of technical interest.

ELECTRO-CHEMISTRY.

Electrolysis of Copper.—In a short article by Mr. Blount, in the London "Elec. Plant," he states that in the Hoepfner process the accumulation of iron salts in the bath, which is a constant source of difficulty, is dealt with by neutralizing the acid electrolyte and blowing in air, which precipitates the iron as ferric hydrate, and converts the cuprous chloride into cupric chloride. In Mr. Swan's process the influence of foreign matter in the electro-deposition of copper is overcome by adding a minute quantity from 2 to 3 parts per 100,000 of gelatine to the solution of sulphate of copper, the gelatine having been previously oxidized by nitric acid; with this the enormous current density of 144 ampères per square foot can be used without causing the formation of granular deposits; the deposit is not only coherent and of even thickness, but is hard and bright.

Electrolysis of Steam.—The London "Electrician," July 14, reprints an abstract of a Royal Society paper by Prof. J. J. Thomson, in which he describes his researches in the electrolysis of steam, by means of the spark and the arc. He describes the researches made by Perrot as early as 1861, and arranged his apparatus so as to overcome the objections to that used in these early researches; a cut showing the apparatus is given; the present instalment consists of a description of the apparatus and the methods of making the experiments; the results are to be given later. In some editorial comments on this paper, it is stated that the elements, hydrogen and oxygen, exhibit either an electro positive or an electro-negative property, according to the length and character of the spark: when the current passes in the form of an arc, hydrogen is evolved at the positive electrode, while, when evolved at the negative, the discharge shows all the characteristics of a spark; the whole phenomenon appears to be involved in mystery.

A New Alloy.—The Lond. "Elec. Rev.," July 14, mentions that a new alloy has been discovered by electrolysis. Bohemian wolframite, rich in rare metallic tungsten, when subjected to electrolysis, yields a metallic alloy composed of iron and tungsten; the alloy is silver-gray, very heavy and very hard, about as hard as corundum. It is suggested in that journal that this process might result in a novel and probably lucrative method of obtaining ferro-tungsten and ferro carbo-tungsten.

MISCELLANEOUS.

Generating Exceedingly High Temperatures.—Messrs Lagrange and Hoho, before the Belgian Academy, stated that temperatures of 800,000° C. can be reached by means of the process discovered by them (this process consists in passing a strong current through an electrolytic bath, in which case the cathode becomes heated to a very high temperature; for a description of the process see the Digest, April 29, and July 8, under Welding; also The Electrical World, June 10. p. 430, and July 15, p. 42). The quantity of he a given off per square centimetre of the surface of the electrode is equal per second to E I + 4.200 S, in which E is the potential between the liquid and the electrode, I the current and S the surface immersed in square centimetres; the current density increases with the conductivity, but not proportionally; with a solution of 55 5 per cent. by weight of sulphuric acid, 75 volts and a current density of 12.5 ampères per square centimetre, the energy expended is 0.223 calorie; for higher voltages the current increases very nearly as the square root of the voltage; if the voltage is 625, the current will be 37.5; that is, three times as much, and the heat given off 27 times as great, or 5.921 calories per second per square centimetre; this already produces a temperature considerably higher than that of an arc of equal surface; taking, for instance, an electrode of a plate of graphite 1 millimetre thick and 1 centimetre square, in a 10 per cent. solution, and with a voltage of 1,875, the current will be 62.5 ampères per square centimetre, and the heat generated per second 64.62 calories, which, from calculations, is the heat required to raise the plate to a temperature of 828,460 degrees C. (This supposes that the state of the graphite does not change, that its specific heat remains constant, and does not take into account radiation and conduction.) There are at the surface of the electrode two actions, an electrical one, and a very intense calorific one, which may enable chemical action to take place with very great energy, and for this reason the process may become an important one. The paper is contained in the Bul. de la Soc. Belge. d'Elec; an abstract will be found in the Lond. "Elec. Eng.," July 14.

Electric Furnace.—The Lond. "Elec.," July 14, gives an abstract of a paper by Mr. Moissan, in which he states that in order to condense the vapors of difficultly volatilized bodies he uses a copper U-shaped tube, 15 millimetres in diameter, through which a current of water circulates at a pressure of 10 atmospheres. The bend of the U-tube is introduced in the furnace 2 centimetres above the crucible containing the substance to be volatilized; the vapors condense in abundance on its surface. Various metals were experimented with in this way. Carbon was thus quickly changed into graphite and into transparent particles of a chestnut color. A more complete description of these experiments will be found in "L'Ind. Elec.," July 10.

Electric Carburization of Iron.—"L'Ind. Elec.," July 10, reprints Mr. Garnier's paper on the subject, already noticed in the Digest, July 22. In addition to what was given in that abstract, the following may be of interest: A second experiment was made in which two like bars of steel were placed end to end and separated by a space of 1 centimetre filled with charcoal; 55 ampères at 2.5 volts were applied for three hours; the anode was not changed, but the cathode was carburized quite deeply, the lower part having even been melted; to avoid the latter he suggests turning the bars first in one direction and then in the other during the process; he concludes that at a temperature of about 1,000 degrees C., and with the aid of small currents of about 50 ampères and at 2.5 volts the carburization of iron takes place very rapidly.

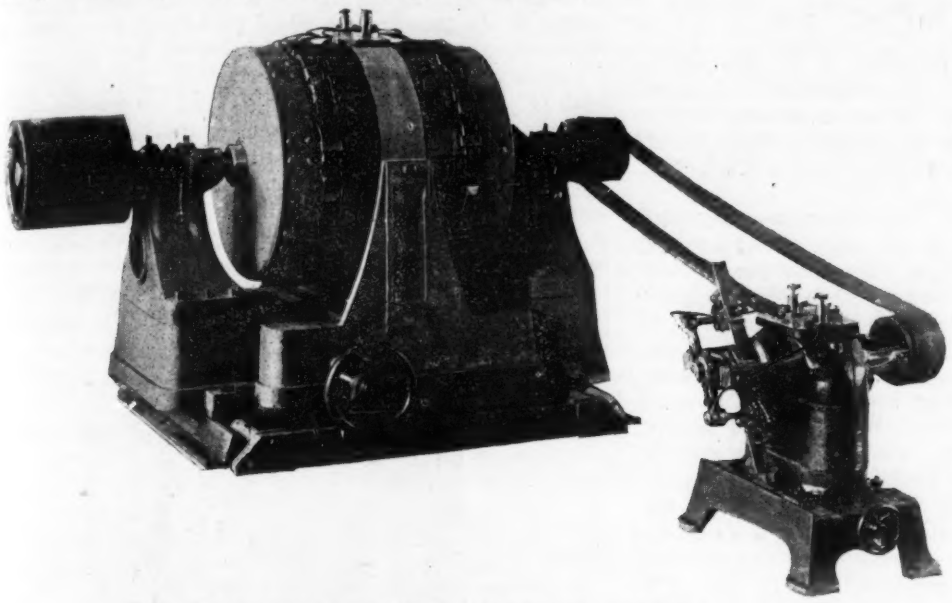
Auto-Conduction.—Dr. d'Arsonval applies this term to a new method of the electrification of the body. In a recent paper before the French Academy of Sciences he describes this method, which consists in passing currents through the body without using any electrodes; the currents are made to circulate through the tissues by placing the subject either entirely or in part in an oscillating magnetic field of very high frequency; wire is wound round a cylinder of insulating material, and the subject is placed inside of this coil, which is being traversed by discharges from a condenser with a frequency of 200,000 by bending the arms so as to form a circle, and closing the circuit with a lamp; the lamp will light up without causing any sensation, the condenser consists of from 2 to 12 Leyden jars, 50 centimetres high and 20 centimetres diameter, arranged in two groups in cascade; they are charged from a 15,000-volt transformer connected to an alternator giving 12 ampères and 360 volts at a frequency of 60.

The Royal Alternating Current Dynamo.

A characteristic feature of this dynamo, which is manufactured by the Royal Columbian Electric Company, of Chicago, Ill., is that both the field magnets or the exciting coil and the induction coil are stationary, and there is no need therefore of commutator or collecting rings, brushes or brush-holders to conduct the current generated by the introduction of sliding contacts. The greatest advantage, however, lies in the fact that the original insulating qualities can be maintained longer than can be done if the coils are revolved or subjected to mechanical strain. It is, therefore, practicable to build this machine for unusual high E. M. Fs. and still operate it with perfect safety. Another important feature is that in case one or more of the induction coils become damaged by accident or otherwise, it can be easily and quickly replaced.

For these reasons, therefore, it is claimed that this dynamo can be maintained at a minimum cost. To accomplish this the following points were aimed at by the designer: As will be seen from the illustration, the machine is supported by a substantial base, in the centre

of which is a saddle, for the purpose of supporting the armature frame, the latter being bolted firmly to the saddle. To the outside of the armature frame are bolted the armatures proper, which are built up of soft sheet iron and carry on their extreme end the induction coils. To the inside of the armature frame is firmly held the main magnet spool; the spool and winding, however, cannot be seen in the cut. At the extreme ends of the base the bearing supports are firmly bolted, and they carry at the top a bronze metal bearing; the shaft is of



THE ROYAL ALTERNATING CURRENT DYNAMO.

hammered steel and contains the rotating parts, which are the main magnet core and the two pole pieces, one of which is still in firm contact with each end of the magnet core; the shaft passes through the hole; the pole pieces have extensions, the shape and size being about that of the armature, but only about one-half the number. They are in close proximity to the armatures, thus making the magnetic resistance very low. The open spaces between the extensions of the pole pieces are filled out with non-magnetic substance, thus giving the poles a disc like appearance. The revolving parts do not contain anything that may get out of order, and there is claimed to be absolutely no wearing except in the two bearings, which are extra large, and self-oiling.

The regulation of the machine may be compared to that of a well designed shunt dynamo; a shunt wound dynamo is used for the exciting circuit, and provided with rheostats in the shunt field circuit, divided into a number of units, so as to compensate for any difference in the E. M. F. The results of a number of accurate tests show, it is claimed, a high efficiency, which has, in a number of cases, exceeded the guarantee of the company, while the cost of operation and maintenance is exceedingly low.

The "Perfect" Battery.

The Fitch "Perfect" battery, now manufactured by the Galvano Faradic Manufacturing Company, 300 Fourth avenue, New York, consists of a carbon cylinder, a square rod zinc and the "Perfect" battery excitant. The carbon is neatly molded into the form of a cylinder with the top closed except where the zinc enters; positive con-

AN IMPROVED PRIMARY PATTERY.

nection is made to a lug molded on this top. The upper part of the cylinder and the top are impregnated with paraffine, which prevents the solution from evaporating.

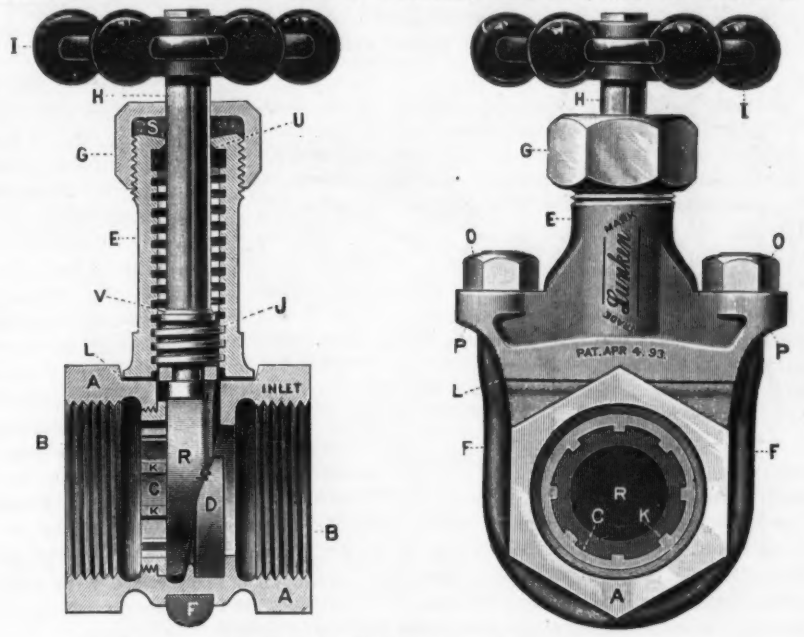
The zinc fits into a porcelain cylinder, which, in turn, enters the hole in the carbon top, and is kept in place by a flange; the zinc is bushed with a rubber where it enters the porcelain, thus making a tight joint through which the solution cannot evaporate or moisture reach the wire connection. An excellent feature of this battery is that the zinc and carbon line connections are not exposed to corrosion or to moisture from the cell, which are such fruitful sources of trouble with many other forms. The different processes practically seal the cell, which reduces attention to a minimum.

The excitant used is not a secret preparation, but one whose composition can be seen to be based upon correct principles by reference to the patents, whose dates are given. It is not only an excitant, but has also depolarizing qualities, although it contains no acid that will injure the finest fabric. There is no local action and consequently no wear when the circuit is open, and the liquid does not "crawl."

A New Gate Valve.

A new gate valve has been placed on the market by the Lunkenheimer Company, Cincinnati, O., which, besides the usual superiority over globe valves, possesses several new features that will be appreciated by users; among these are a seat that can be readily renewed, a bye-pass on the larger valves which balances the disc before opening and thus reduces the pressure, and wedging surfaces so formed that the valve will not stick.

Referring to the illustrations it will be seen that the hub or bonnet of the "Lunken" valve is held to the shell by a coppered steel clip or strap surrounding the shell, with its ends passing through the ears of the bonnet, and secured by nuts O. This clip is held from lateral movement by projections on the shell. The joint is packed by a hard leather washer of 1-64th inch in thickness, the top faces of flanges each having a groove to properly secure the washer. The valve can easily be taken apart without renewing the packing washer. The hub or bonnet is flat and narrow, and just of sufficient size to receive within it the valve disc when entirely raised, and has sectional or part-nut threads in its opposite interior sides for the threaded portion J of the stem. The disc has a straight flat face or bearing against the renewable seat C, and is forced tightly against the same by the self-adjusting wedging half-ring or horseshoe D, secured loosely in the valve shell. The wedging on the disc is applied on two wedging surfaces diametrically opposite to each other, these coming in contact with the beveled ends of the half-ring or horseshoe wedge; thus the wedging pressure is properly equalized on the entire disc and insures a tight joint on the opposite face. The pressure of the steam or liquid on the back or wedge side of disc also aids to make a tight closing valve. The renewable seat is an exteriorly threaded flanged ring that screws against a face or shoulder of the flange, the opposite side of which flange forms the seat or bearing surface for the disc to close against. The inner periphery of the renewable seat has lugs or teeth K for the engagement of a spanner end, by which means, after taking off the bonnet E, the seat is tightened or loosened through the disc opening of the body, without disturbing the pipe connections. In iron body valves the renewable seat C screws into a second brass ring, permanently fastened in the iron shell; otherwise, owing to the rusting qualities of iron, the removable seat might rust tight in the shell. In a few minutes, and with perfect ease, any person can practically make a worn out "Lunken" gate valve as good as new, the cost of the renewable seat or a new disc being but trifling. Another important feature is that the stem, when the valve is full open, seats itself (V against U), thus relieving all pressure on the stuffing box, and permitting repacking of the same under pressure. The tie band surrounding the shell adds greatly to the strength of the entire valve, and permits of its being taken apart easily with a small wrench. The shell is so short and rigid, and the wedging surfaces are so small, that expansion and contraction do not affect it. Thus the disc will never wedge fast and become inoperative, which is the case in many styles of double seated gate valves. Having but a single disc, and the wedging half-ring taking the place of a second disc, as a wedging resistance, this construction overcomes the objection in double disc gate valves, where liquids remain in the shell between the discs, and often freeze or injure the valve. It is impossible for anything to lodge on the seat of this valve, because the disc and seat have a parallel straight face; and as the pressure on the back of disc keeps it tightly pressed against its seat, it actually cuts away (like the action of the blades of a pair of shears) anything in its path. This feature, combined with the renewable seat, commends this valve for blow-off purposes.



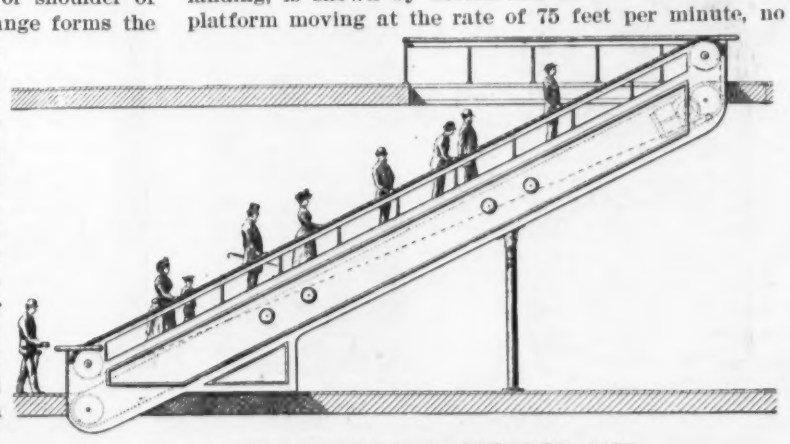
DETAILS OF THE "LUNKEN" GATE VALVE.

An Inclined Electric Passenger Elevator.

One of the features of American life upon which the writer has heard most favorable comments by foreign visitors to the United States has been our admirable elevator service, which they are inclined to consider most typical of our civilization. Like every application, however, that at first is considered a wonderful advance, then taken as a matter of course, and finally criticised for defects, the habitual users of elevators now growl at the delay in waiting for a car, and righteously so at the disagreeable crowding often experienced. The new form of elevator we illustrate obviates both of these defects, and, while perhaps not applicable for all purposes, has yet a wide range of usefulness.

The Reno inclined passenger lift, manufactured by Otis Bros. & Co., 38 Park Row, New York, is designed for use at elevated railway stations, retail dry goods stores, theatres, and other places where the transfer of people from one level to another is necessary, and, moving continuously, is admirably adapted for elevating a large number of passengers rapidly and comfortably. The general appearance of the elevator when in use is shown in the illustrations. It consists of an endless inclined platform, which moves at a uniform speed, and upon which the passengers step and are transferred from one landing to the other. In addition to the platform, there is a moving hand rail, which serves to steady the passenger in his ascent. The platform is made up of a series of iron sections, supported on rollers, linked together and running on tracks.

The mechanism for operating the platform consists of two pairs of sprocket wheels, the teeth of which engage with projections on the sections. The location of these wheels, one pair at the top and one at the bottom landing, is shown by dotted line in the cut. With the platform moving at the rate of 75 feet per minute, no difficulty is experienced in stepping on or off, or in maintaining the foothold or equilibrium, even without using the moving hand rail.

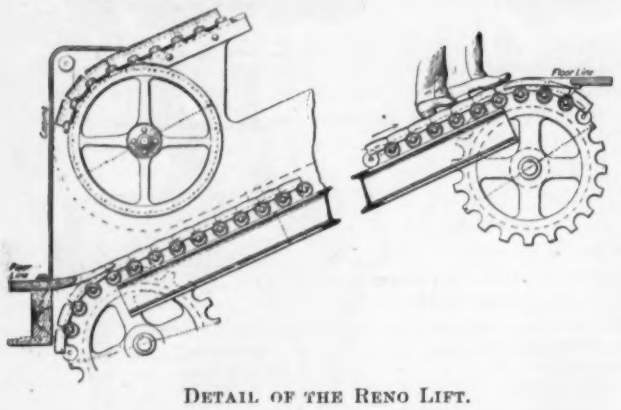


THE RENO INCLINED PASSENGER LIFT.

It will be seen that the foot of the passenger, resting as it does upon the longitudinal ridges, will, when it arrives at this point, be gently slid upon the combed landing, and the slight friction thus produced will sufficiently retard the lower part of the body to cause the passenger to involuntarily step forward and thus make room for the person immediately behind him. The prongs of the combed landing are carried down to the bottoms of the grooves between the ridges of the platform, which

thus makes it impossible for anything such as a lady's dress to be caught. In fact, so perfect is this action, that cotton waste and rags have been thrown upon the platform of the machine now in operation in Brooklyn and have been transferred to the combed landing without showing the slightest tendency to catch.

The maximum capacity of a single-file elevator is, approximately, 3,000 passengers per hour, while that of a double-file elevator, provided of course with a moving hand rail on each side, is twice as great. As the machine is perfectly balanced, the power required is directly proportional to the number of passengers elevated, very little power being used in moving the machine itself. No elevator boy being required, considerable economy is effected on this account.

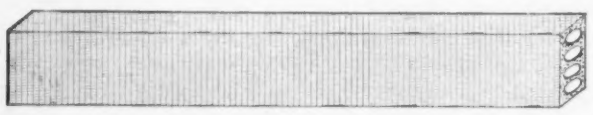


DETAIL OF THE RENO LIFT.

The speed required being constant, it is evident that the electric motor is admirably adapted for running this elevator (although other forms of power are also suitable), and it is equally evident that it will be impossible to suddenly load the motor to its full capacity, as passengers can only step on the elevator one at a time.

A New Commutator Brush.

In our issue of July 1 we described a commutator brush made by J. C. Koch, Hohenlimburg, Germany, the description being taken from the patent specifications. We learn that the brush as now manufactured differs considerably from the one described, and our illustration gives some idea of the new form.



THE KOCH COMMUTATOR BRUSH.

Metal tubes, as shown, of aluminium, are used in connection with fine woven wire cloth of chemically pure copper wire. The body of the brush is solidly made up of the tubes and wire, and is then covered with a copper wire mantle finely woven after the manner of lace. The tubes give the necessary stiffness to the brush. It is claimed that sparks are entirely absent when this brush is used, that the brush has a longer life than other forms, that humming at the commutator is removed, and that the commutator is polished, thus increasing its conductibility and giving it also a longer life.

Dry Electropoion.

The question of the shipment of acids for primary batteries has always been a stumbling block to their introduction; but the preparation of a new, dry compound of sulphuric and chromic acids, which has been given the name Chromite by the manufacturers, Bryan, Marsh & Co., 136 Liberty street, New York City, will meet a demand of large proportions from the trade, as by its use the complete avoidance of shipment of battery fluids by carboy or bottle is accomplished.

DRY ELECTROPOION.

Upon dissolving two pounds of chromite in one gallon of water, a solution is obtained having a slightly higher electromotive force than electropoion of the same density, and which is guaranteed by the manufacturers to be free from bichromate of potash or other fuming or deleterious matter. In appearance chromite resembles chromic acid, and is nearly as soluble; this feature, preventing the walls of porous cups from becoming clogged by undissolved particles, unlike bichromate of potash, is especially meritorious. The new compound permits of a density of 55 degrees Beaume before forming a saturated solution. The resistance in ohms is very low. This compound is said to embrace the good points of their Kolon solution, which has an established reputation.

Arc Lamps on Railway Circuits.

In connection with the reference to the use of arc lamps on railway circuits, which was made in a recent issue of The Electrical World, the following extract from a letter received from the Scott Electrical Manufacturing Company, 89 Liberty street, New York City, is of interest:

"We notice in your very interesting article 'Electricity at the World's Fair,' page 62, of your issue of July 22, 1893, the following paragraph: 'We have yet to hear of the attempt in this country to place eight constant potential arc lamps in series on a 500-volt circuit.' In reply to this we would say that in the spring of last year we installed on the line of the Allentown and Bethlehem Rapid Transit Company, at Allentown, Pa., three circuits of eight each on their 500-volt railroad circuit, and would state further that the company is entirely satisfied with working, as testified by their manager, viz.: 'We are now using to our entire satisfaction the eight lamps in one circuit, and will say we are entirely pleased with them.'"

A New Open Circuit Battery.

Owing to the great demand for open circuit batteries for telephones, bell work and other applications there are many forms of these on the market, among which the cells manufactured by the Law Battery Company, 85 John street, New York, have long held a high rank, not only on account of their electrical efficiency, but also from the careful workmanship shown in their construction. This company has recently added another battery to its list, the details of which we illustrate, that embraces several new features.

Carbon porous cups, as heretofore made for open-circuit work, have been filled with manganese and then permanently closed by filling or plugging with wax, which it did not pay to remove, so that when the element had lost its efficiency through the depolarizing agent becoming exhausted the carbon cup has been thrown away and a new one substituted.

Fig. 1 shows the carbon porous cup of the new cell with its removable carbon cover, which allows the renewal of the manganese or depolarizing agent whenever it has become exhausted or deteriorated through over work. This cup and cover will do duty for an indefinite number of renewals of the depolarizing mixture.

Fig. 2 represents the cover carrying the zinc rod. This cover is introduced between the carbon porous cup and its screw cover, and is tightened and held in place when the carbon cover is screwed into the porous cup.

The screw cap is made of dense carbon subjected to high pressure, and the minute pores are sealed by a treatment which renders absorption of moisture impossible and corrosion consequently out of the question.

A special circular zinc is made to go with this cell, which differs from the ordinary form in that the stem or pencil attached fits into a socket in the cylindrical zinc, and the stem on emerging from this socket is bent forward from over the carbon element as much as possible and then passes up through the surface of the liquid to and through the cover.

THE LAW OPEN CIRCUIT BATTERY.

A New Gravity Drop Cut-Off.

A new gravity drop cut-off for electric gas lighting apparatus which will be particularly appreciated for use on combination gas and electric light fixtures, has been recently placed on the market by A. L. Bogart, 22 Union Square, New York. The cut-off, we are informed, operates on an improved thermic principle, in which, however, the thermic expansion element performs no mechanical part whatever, the breaking of the circuit as well as the movement of the indicating drop being performed by the electric current. All parts are positive in their action, it being unnecessary to make the parts weak and fragile, in order to obtain sensitiveness. The main contact closing the battery circuit is of large extent and normally locked, insuring positive continuity without resistance, the unlocking and breaking of the circuit at the proper time being performed by a large electro-magnet operated by the full battery current.

The indicator announces the fact that the circuit is open or closed, in large, full letters that are readily discernible. The circuit once broken by the instrument is again closed by pulling downward the pendent acorn beneath the case. The adjusting screw is placed outside the case at the right hand side, and is employed to increase or diminish the time during which the circuit may be kept closed at a burner without the instrument acting to cut off the battery, and is useful where either the battery employed is stronger or weaker than the normal strength usually employed. By this screw the duration of closure of the circuit can be varied from one to thirty seconds. The instruments are usually adjusted for from five to six seconds.

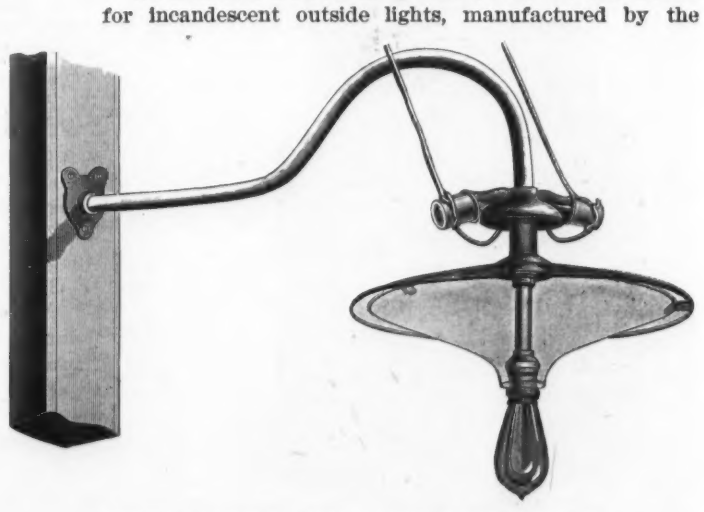
GRAVITY DROP CUT-OFF.

A small galvanometer is set in the front of the instrument, over the indicator window, which permits the discovery of leaks on the circuit; is further useful in adjusting, and instantly shows, when resetting, whether the ground is still on or not.

The construction of the instrument is such that the thermic time element acts as a perfect safety fuse, which will instantly open the gas lighting circuit should a cross occur between the gas lighting and the incandescent lamp circuits. The bell itself is normally out of the circuit, and any burners may be operated as frequently as required without the bell sounding at all. If, however, the battery become short circuited or grounded at a burner or elsewhere for more than the given period of time for which the instrument is set, the bell is thrown into the circuit and sounds continuously as long as the trouble continues. When the ground is removed, the bell is automatically cut out of circuit and the battery left in as before. Another new feature is that the bell is actuated by the main battery, and the current flowing through to the ground diminished to so small an extent that the ground can be left on for hours without seriously affecting the battery. Thus, while the current to a burner from the ordinary battery will be one ampere, when the bell acts it will diminish immediately to less than three-tenths of an ampere.

A Street Lamp Shade and Reflector.

We illustrate a street lamp shade, reflector and fixture for incandescent outside lights, manufactured by the Hawks Electric Company, 174 Summer street, Boston, Mass. The reflector is enameled, and therefore will not turn dingy and brown as is too often the case with painted reflectors.



STREET LAMP SHADE AND REFLECTOR.

The shade of the "Hawks Fixture" is firmly held between two iron washers, clamped by a lock-nut. The iron hood prevents moisture from getting inside the fixture, and also answers as a support for the wires. The arm is of sufficient length to bring the lamp four feet from the pole, and the flange is amply strong to support the fixture without bracing, and can be used for either three bolts or two as desired. The fixture is neat in appearance, durable, and thoroughly weatherproof.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 29, 1893.

Electrical stocks cannot expect to show much improvement in quotations in times when the whole Stock Exchange list is forced to yield to the pressure exerted by the unhappy conditions surrounding the stock market. For a time during the week ending to-day, it seemed as if the rally so long awaited had really set in. The determination of the banks to help along in every possible way the gold import movement and the actual beginning of the return flow of the yellow metal lent some show of life to one or two days' trading, but for the most part the liquidation induced by the financial stress has continued, and stock quotations this week made another record for low prices. In this general depreciation of values the electrical stocks have not been absent. In fact, both General Electric and Western Union, the two electrical securities that are active in the New York market, sold this week for the lowest prices yet.

General Electric sold to day for 30; the net decline for the week 15 points. Pressure has been brought to bear upon this stock during the week, and it has been sold right and left with a confidence seemingly born of a knowledge of trouble to come. When an 8 per cent. stock sells for less than one-third of its par value, Wall Street is constrained to believe that something radically wrong must exist. It is argued that the friends of the property would render some more material support to the stock other than merely contradicting the many detrimental tales circulated regarding the stock, were they not aware of some untoward circumstances affecting the property. Acting upon this supposition, the bears have gone short of the stock with a recklessness that shows how thoroughly the stories of an impending receivership and of financial distress have been believed. It is very hard to gather definite data regarding the status of the General Electric Company. As remarked above, the officials of the company have not been slow to give contradiction to the current stories. The most definite of these reports was to the effect that the floating indebtedness of the company, despite the confident assertions of interested persons that it was financially sound, had become so unwieldy that, like the Erie Railroad, it would be forced to seek the protection of the courts in preference to extending notes at ruinous rates of interest. The directors on Friday at length felt the necessity of stopping in some way these malicious reports. In the first instance the counsel of the company stated explicitly that they were altogether unaware of any proceedings looking to placing the company in the hands of a receiver. Next, the directors issued this official statement: "It has been decided to offer to the stockholders of the company securities now in the treasury sufficient to pay the entire floating debt of $4,000,000. Of the amount necessary to underwrite the above, 70 per cent. has already been subscribed." A quietus was also put to another rumor by the emphatic declaration that the quarterly dividend of 2 per cent., payable Tuesday next, would be paid, and that in cash, and not, as otherwise reported, in scrip. To some people the fact that the company has a large floating debt comes somewhat in the nature of a surprise. The course of the stock to-day showed how that, the more the policy of the directors is studied, the wiser it is seen to be. The assets which the directors have determined to offer to the stockholders at prices that will bring at least $4,000,000, the amount of the floating debt, consist of stocks and bonds of corporations which the General Electric Company has accepted in payment for "privileges, rights and apparatus" furnished the subordinate companies. The syndicate underwriting the subscription to 75 per cent. of these treasury assets is composed of such people as Drexel, Morgan & Co., ex-Governor Ames, of Massachusetts; D.O. Mills, H. McK. Twombley, H. L. Higginson and T. Jefferson Coolidge, all Boston and New York capitalists identified with the General Electric Company. These names are a guaranty of strength; and the knowledge that they are willing to stand by the General Electric Company in its troubles will do much to create a better feeling toward it. For it cannot be denied that the company has been hard hit by the frightful slaughter of its securities, not so much by the stock market decline as by the distrust created thereby. Moreover, the securities of other companies held by it have suffered much depreciation in the general commercial shakiness overrunning the country, and the balance sheet of the company must have undergone some material changes. A stock market rumor concerning General Electric that was current during the early part of the week stated that Drexel, Morgan & Co. had secured control of the company and that changes of importance in the management were pending. Drexel, Morgan & Co. have always been active in the company, but while they probably have increased their holdings, they are not likely to assert themselves more than they have; they don't need to. Boston has, of course, viewed the decline in the stock with the greatest alarm, and, if anything, Boston holders have been more severely hurt than the New York contingent. The Easterners have made every effort to stem the tide, and, that they have not lost all faith is shown by the fact that on Thursday $500 was bid on the Boston Board to call 500 shares at 60 for 30 days.

Western Union Telegraph stock loses for the week 7 points. Its fluctuations haven't been anywhere as violent as those of General Electric, and its strength is attributed to the determined operations of a new bull pool. This has prevented the bears from making as much headway as they wished, and they have only been moderately successful in their efforts to stampede holders of long stock. The most contradictory reports are in circulation regarding the earnings of the company. That they must be decreasing, any one acquainted with the situation must be fully aware. This is partially admitted by the officials of the company, who aver, however, that they have not decreased to such an extent as to warrant a reduction of the dividend. It is even alleged that the revenue for the current three months will be at least $1,900,000, as against $1,750,000 for the previous quarter. This, while not up to the same period in 1892, assures the continuation, for the present at least, of the payment of dividends at the rate of 5 per cent. per annum. Bears have also been making capital of the fact that statements of test office receipts have not been given out of recent weeks, and it has been stated that they have been held back so as to conceal the large falling off in earnings. The fact of the matter, as asserted at 195 Broadway, is as follows: "Some of the directors to whom these figures are given since they are members of the Executive Board, have, in times gone by, at infrequent intervals, made known the statement. This was entirely voluntary on their part and could not be regarded as any official act of the Western Union Company. It may nevertheless be stated that the earnings, even though they show a slight falling off in general business, have been kept up largely by regular business, which is unusually large, and reductions have taken place in expenses; there is less construction going on, so when the statement comes out in due course, which will be on Wednesday, Sept. 13, the net figures will be shown to have held their own."

Westinghouse Electric securities have through all the current depression kept rather much in the background. There is no trading in either the preferred or common stock of the Westinghouse Electric and Manufacturing Company worth mentioning. As a result of this inactivity, however, they have not shared much in the general fall in values. The officials say that the stock is held almost entirely as an investment security, and there are over 3,000 recorded holders of the common stock. Considering there are only 120,000 shares of the common stock, the transfer books show that it is pretty well distributed.

Fort Wayne Electric has had a little attention accorded it in view of a revival of the report that R. T. McDonald, now in control of the company, is once more at loggerheads with the General Electric Company, with which it is allied, and the Fort Wayne Company will break away and be run in opposition to the big combine. The stock has done nothing in a long time and there doesn't seem to be anything in prospect to influence its quotation in either direction.

The American Bell Telephone Company makes a report of instruments in use on July 20, 1892, which bears out the argument advanced in these columns in the past two letters, that decreased earnings of the telegraph companies are due to increased uses of the telephone. The telephone company shows that on the date mentioned there were in use 579,434 instruments, an increase of 40,800 as compared with the number in use on July 20, 1892. The stock of this company has gone down two points, 166 being now bid, as compared with 170 last week.

The Erie Telephone Company reports a similar increase in the use of this method of communication. Notwithstanding the loss of 77 subscribers by the recent fire at Fargo, the sub-companies of the Erie Telephone Company made a net gain for the quarter ended June 30, 1893, of 152 subscribers, and now have connected over 15,000 subscribers. It thus is seen that all over the country people are beginning to use the telephone more, to the detriment of the telegraph service. The directors of the company have just declared the usual quarterly dividend of one per cent., payable August 14.

The New England Telephone Company has also declared a dividend of 75 cents a share, payable August 15.

The Edison Electric Illuminating Company, of New York, reports that its net earnings for the first half of 1893 were $282,302, an increase of $56,736. The Edison Electric Illuminating Company, of Brooklyn, shows a surplus for the first six months in the year of $60,095, an increase of $28,954.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	90	91
" " " Ists	...	99	100
Edison Electric Ill., Brooklyn	100	93	98
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	9	9½
General Electric Company	100	38	38¼
" " deb. 5's	..	60½	61
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	18	20
" pfd	50	37½	40
Western Union Te	100	68¾	68⅞

TELEGRAPH AND CABLES.

	Par.	Bid.	Asked.
American District Tel	100	54¾	55
American Tel. & Cable	100	83½	84
Central & So. Am. Tel	100	..	111
Commercial Cables	100	137	140
Gold & Stock Tel	100	100	103
Franklin	100	35	50
Mexican Telegraph	...	180	200
Northwestern Telegraph	...	100	100
Pacific and Atlantic	...	56	...
Postal Tel. & Cable	...	....	72
Southern & Atlantic Tel	25	77	80
Western Union	100	68¾	68⅞

TELEPHONE STOCKS.

American Bell	...	170	175
Erie Telephone	.	40	42
New England Telephone	...	49	50
N. Y. & N. J. Telephone	...	92	95
Metropolitan Tel. & Tele Co	...	104	....

AFFAIRS OF THE COMPANIES.

The Wisconsin Electric Light and Power Company has decided to erect a factory in Layton Park, Wis., for the manufacture of dynamos.

The California Electric Light Company, San Francisco, has elected the following officers: President, John R. Spring; vice-president, George H. Roe; secretary, J. R. Green; treasurer, the Nevada Bank.

The La Roche Electrical Company, of Sixth and Arch streets, Philadelphia, has purchased Schepper Bros.' six-story mill building, at American and Diamond streets. The building is 86 by 100 feet in dimensions.

Edison Light and Power Company, of San Francisco, Cal.—At the annual meeting of the Edison Light and Power Company 14,984 shares of the 15,766 shares of issued stock were represented, and the following directors and officers were elected: George H. Roe, president; Gustave Sutro, vice-president; L. T. Hagzin, Willis E. Davis, John R. Spring, P. B. Cornwall and Arthur W. Moore, directors. Joseph E. Green was appointed secretary and the Nevada Bank treasurer. The Edison Light and Power Company is paying 8 per cent. per annum in monthly dividends of 66⅔ cents per share each.

NEW INCORPORATIONS.

The South Peoria Railway Company, Peoria, Ill., capital stock $100,000, has been formed to construct and operate electric and other railways. C. A. North, I. M. Hornbacker and J. W. Culbertson are interested.

The Sioux City Electrical Supply Company, Sioux City, Ia., capital stock $100,000, has been formed to manufacture and deal in electrical machinery and supplies. The promoters are H. D. Woodruff and S. G. Nilson, of that city.

The General Machine and Electric Company, New York, maximum capital $5,000,000, has been formed to make and sell electrical machinery, etc. Granville Woods, New York City, and Wm. S. Hanford and Oliver Duncan, of Brooklyn, are interested.

The Goliad Water and Light Company, Goliad, Tex. capital stock $30,000, has been formed to supply electric lighting and water to that city. J. H. Ewell, R. R. Stout, W. B. Campbell, L. A. Maetze, J. W. Cole, L. Seeligson, Jr., and R. T. Davis, all of Goliad, are interested parties.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, July 31, 1893.

Mr. A. Wilzin, of the E. W. Bliss Company, and wife are summering at the Pavilion Hotel, Staten Island.

The Brooklyn Elevated Railroad Company state that its losses from trolley competition are $30 per day.

Mr. George McKinlock will hereafter have charge of the business of the Central Electric Company, 116 Franklin street, Chicago.

The Clamp Socket Manufacturing Company, 39 Cortlandt street, New York, has changed its name to the Newton Electric Company.

Mr. H. T. Paiste, the well known switch manufacturer, of Philadelphia, left for Chicago last Sunday evening, where he will remain a couple of weeks.

P. A. B. Widener, of the Metropolitan Traction Company, states that within 30 days work will be begun to cable the Lexington and Columbus avenue roads.

Brooklyn, N. Y.—The building No. 1,433 De Kalb avenue took fire and the stock of electrical supplies of Wm. Ostrander & Company was damaged to the amount of $1,000.

Brooklyn, N. Y.—The Aldermen, at the Mayor's suggestion, have rescinded the electric railway franchises on portions of the following streets: Madison street, Greene avenue, Gates avenue, and Livingston street. It is hinted that some, or all, of these were included in the franchises with the purpose of having the Mayor direct them to be stricken out.

Mr. P. C. Ackerman, New York representative of the American Electrical Works, is receiving the congratulations of his many friends on account of a recent happy event in his family relations, the arrival of a 10-pound scion. They do say that Phil captures all the fine contracts for wire, but he will have to look to his laurels now as there are but a few years between the child and the man.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 29, 1893.

The Schuyler Electric Company, Middletown, Conn., has recently completed the largest search light in the world. The lens and the mirror back of the lamp are each 5 feet in diameter, and the light is of 375,000,000 c. p.

The Lynn & Boston Horse Railroad state that within a month's time a five cent fare will be established to cover that part of their road running through Malden, also that the road will be equipped electrically from Belmont Hill to Central Square, and within four months the electric cars will be running to Chelsea.

The creditors of Jerome Redding & Co., electrical engineers and manufacturers of electrical goods, No. 48 Hanover street, Boston, Mass., have decided to have the business continued by the assignee, the committee continuing to act in an advisory capacity in co-operation with him. The direct liabilities are about $6,500 and the indirect $500, while the assets nominally aggregate about $12,000. It is thought that the creditors will eventually be paid in full.

The Brown Electric Company, of Boston, Mass., has made some radical changes in its business, and has been obliged to increase its quarters by the addition of a storage warehouse. Hereafter Mr. Eliot O. Johnson will take charge of the electric lighting sales department Mr. M. W. Brown is giving his special attention to railroad equipments. Mr. Johnson will continue to sell Holmes, Booth & Hayden wire, and both Mr. Brown and Mr. Johnson report business in their respective departments as excellent.

The Boston "Transcript" is authority for the following: It is stated by the officials of the General Electric Company that the reports relative to the alleged discharge of a large number of their employés, as a result of business depression, are incorrect. They state that instead of about 700 men being discharged recently, the number has not exceeded 250 for a long time. Their payroll for the present week amounted to $51,000, being the largest they ever had. Relative to public rumors as to a shutdown in the iron foundry of the Saugus River Works of the company, Superintendent Rice's private secretary, Mr. Broderick, says that he knows of no reason why such a rumor gained circulation.

PITTSBURGH NOTES.

PITTSBURGH, July 29, 1893.

A rich mine of asbestos has recently been discovered near Harper's Ferry, Va., by Dr. A. D. Miller, of Mt. Pleasant. Dr. Miller some time ago bought a large tract of land in that section, and, having reasons to believe that the land was underlaid with valuable minerals, the doctor caused an investigation to be made, which has developed into the discovery of several veins of particularly fine asbestos.

The Atterbury glasshouses and Factory K of the United States Glass Company, of this city, started last Monday morning with the manufacture of incandescent lamp bulbs. It will be remembered that until recently this industry was monopolized by some glass houses in the East; this move, however, is the result of a special arrangement arrived at during a convention of glassmen held some time since.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 MONADNOCK BUILDING, CHICAGO, July 29, 1893.

Chas. C. Lockstaedt has swindled Chicago banks out of $88,000 on notes forged on the Westinghouse Electric and Manufacturing Company.

Clarence A. Black has been appointed a member of the Detroit, Mich., Electric Light Commission in place of Mr. Newcomb, who resigned on account of poor health.

Mr. W. C. McKinlock has severed his connection, officially and financially, with the Central Electric Company of Chicago and its branches, and sailed for Europe on July 26, where he will remain about three months.

The Northwestern Electrical Association held its first semi-annual meeting at Madison, Wis., on July 19 and 20, under the presidency of C. C. Paige. Among the papers read were the following: "Legislation for Private and Municipal Electric Light Companies," by H. C. Thom, Madison, Wis.; "Relative Merits and

Demerits of Engines for Electric Light Stations," by J. S. Stephens, Massillon, O.; "Gas Engines as Motive Power for Central Stations," by Geo. A. Farwell, Waukesha, Wis.; "The Accuracy of Meters," by Prof. D. C. Jackson, University of Wisconsin; "Arc Lights on Alternating Currents," by J. D. Putman. Mr. George Cutter, of Chicago, assisted by Mr. F. McMaster, delivered a lecture, illustrated by experiments, on "The Forces of Molecular Action." Among those in attendance were the following: C. C. Paige, president, Oshkosh Electric Light and Power Company; George Cutter, manufacturer and dealer of engine goods, Chicago; P. H. Korst, manager of the Badger Electric Light and Power Company, Racine; Geo. L. Cole, manager of the Fort Atkinson Electric Light and Power Company; F. McMaster, expert electrician, Chicago; W. H. Upham, president Marshfield Electric Light and Power Company; I. C. Hopkins, mechanical and electrical expert, Chicago; George A. Farwell, superintendent, Waukesha, expert; W. H. Thorpe, secretary, Beaver dam, expert; M. A. Burt, superintendent, Baraboo, expert; P. J. McFadden, manager Meter Light General Electric Company, Chicago; E. C. Bunnell, Chicago; W. S. Elliott, Chicago; W. W. Deming, St. Paul; I. H. Finney, St. Paul; W. N. Stewart, Siemens & Halske Electric Company, Milwaukee; I. C. Woodard, "Novak" Incandescent Lamp, Chicago; Willard W. Low, Electrical Appliance Company, Chicago; J. S. Stephens, Russell & Co., Massillon, O.; B. S. Terry, manager A. W. Harris Oil Company, Chicago; J. W. Wiley, Stevens Point Light Company; C. Gunderson, superintendent Madison Electric Light and Power Company; H. C. Thom, manager Madison Electric Light and Power Company; G. H. Shaw, superintendent Madison Street Railway Company.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, July 19, 1893.

Electric Traction and the Telephones.—The joint committee of the two Houses of Parliament which was appointed to receive evidence upon, and draw up a model clause regulating, the future relations of electric traction and the National Telephone Company, has presented its report. In the clause which it recommends for adoption in all bills relating to tramways the traction companies are to use metallic returns (insulated or uninsulated) of low resistance, and to take all reasonable precautions to prevent interference with telephone or telegraph circuits or injury to gas or water pipes by electrolytic action. This is as it should be, and involves nothing which is not already voluntarily done by the tramway people. On the other hand, the right of action of the telephone and telegraph companies is taken away from them if, after the lapse of a certain number of years, they have not done away with the use of earth as a return. The Committee concluded their report with a few general recommendations which are in every way admirable. They state that having regard to the evidence before them they are of opinion that it is not politic in the present state of electrical science to insist on tramways having an insulated return; they are of opinion, moreover, that the best way of getting rid of the telephonic troubles will be for the telephone people to insulate their circuits. With regard to the danger of the public from the lowering of the railway signals by leakage currents, the Committee think that the railway companies can very well avoid this danger by merely metallicizing their signal circuits. As to the injury to the gas and water pipes, the Committee state that this appears to have arisen from a faulty system of construction, and that it is a danger which can be reduced to zero by proper methods of construction. With the clauses and recommendations of the Committee embodied in all future acts of Parliament, there no longer remains any legislative impediment to the advance of electric traction. It is not, however, to be anticipated that we shall in consequence witness an electric traction boom comparable to that with which the United States has been astonishing the world. First of all, the overhead trolley system cannot be recommended to the public taste even by a joint committee. Secondly, there is no great demand for new tramways. Thirdly, there is little or no money in tramways in this country.

GERMAN NOTES.

(From Our Special Correspondent.)

BERLIN, July 13, 1893.

The city of Berlin, for the first time in its history, now possesses a qualified electrical engineer of its own to do its bidding, in the person of Dr. Kallmann, formerly of the *Berliner Elektricitaets-Werke*. The position is remunerated at $1,670 a year. Hitherto it has been the custom to call in some professional consulting engineer to advise the corporation on electro-technical questions.

The report of the *Berliner Elektricitaets-Werke*, dated June 30, which has just been issued for the financial year 1892-93, gives the relative figures for that and the previous year as follows:

	1892-93.	1891-92.
Number of incandescent lamps installed	105,094	87,763
Number of arc lamps installed	5,405	4,516
Number of motors installed	216 (803 h. p.)	120 (430 h. p.

These figures show an all-round increase of 20 per cent. The number of light consumers has risen from 1,782 to 2,100 or about 18 per cent.; and applications pending represent about 19,000 normal lamps (*i. e.*, 16-c. p.), of which 9,000 fall within the Thiergarten quarter where a new accumulator sub-station (which will be charged during the daytime from one of the central stations) is in course of construction. It is interesting to note the advance in the adoption of electric motors, their number having increased by 78 per cent. and their capacity by 87 per cent., and the consumption of energy having risen from 186,611 kw. hours to 238,028 kw. hours. The still more extensive use of electric motors here may confidently be predicted. Some 20 applications are now on the books. The motors are put to all sorts of purposes, from operating an elevator to turning a lottery wheel of fortune. That the much advertised competition of the incandescent gas lighting system is a good deal of a bogey is evidenced by the fact that the total current output reached in 1892-93 53,000,000 ampère hours, as against 45,990,000 ampère hours in 1891-92.

The electric tramway which has been built by the Union Elektricitaets-Gesellschaft, of Berlin, on the Thomson-Houston overhead wire system, at Remscheid, Rhine-Prussia, has just been opened for traffic. The work was completed to the day within the contract time, the first official trial run having been made on June 30. The results attained were eminently satisfactory. The town of Remscheid—a second German Sheffield—is built on the slopes of several hills, and presents in consequence unusual difficulties to traffic, the most frequented streets having grades up to 10½ per cent. A tramway had long been a more than ordinary desideratum, but it was quickly recognized that neither horse nor steam traction was adapted to such conditions. The construction of a cable road was at one time contemplated, but the idea was eventually abandoned in favor of electricity—not without, however, some misgivings at first on the part of the tramway company as to the ability of the electric current to overcome the inherent difficulties of the work. The entirely successful operation of the road no longer leaves room for such doubts. The total length of the line is about four miles. Five motor cars, each provided with two 15-h. p. motors, are in ordinary use, two more motor cars being kept in reserve for extra heavy traffic requirements. The cars each carry 28 passengers, 16 seated and 12 standing; and they are provided, in view of the high grades, with track brakes of approved American type. The station equipment consists of: Two Steinmüller water-tube boilers, each having 121.2 square meters heating surface, and fed by a Worthington steam-pump and Körting injector; two horizontal tandem compound McIntosh & Seymour steam engines, specially adapted for electric railway service, each giving 160 indicated h. p. at 235 revolutions per minute and with an initial pressure of eight atmospheres. These drive by means of belting two 100-kw. Thomson-Houston four-pole railway generators, running at 700 revolutions per minute, and developing current at 500 volts potential. A switchboard, mounted on slate, with all the necessary measuring and controlling apparatus, completes the outfit.

News of the Week.

THE TELEPHONE AND TELEGRAPH.

The Rockford (Ill.) City Council, after several months' consideration, has granted a franchise to the Strowger Telephone Company.

Gautemala, Central America, has been connected with the cable lines of the Central and South America Cable Company, having paid $150,000 for the connecting line of about 10 miles.

Roumaine Callender, of Brantford, Ont., inventor of an automatic telephone, has, it is reported, interested Bay City, Mich., capitalists in his invention, who will build a factory at the latter place.

ELECTRIC LIGHT AND POWER.

Aurora, Neb.—The town has voted to put in an electric light plant.

Springfield, Minn., has voted to bond the city for a municipal electric light plant.

Mayville, Wis.—The village is negotiating for the construction of an electric lighting plant.

Smyrna, Del.—The residents of Smyrna have voted by 1,274 to 130 in favor of an electric lighting plant.

Santa Ana, Cal.—Santa Ana is to vote on the issuance of bonds for electric lights and a city hall.

The Potomac Electric Company, Washington, D. C., proposes to utilize the water power of the Potomac.

Memphis, Tenn.—The great driving wheel of the Memphis electric power house exploded, tearing up the building.

New Haven, Conn.—A drawbridge is being equipped by the General Electrical Company to be worked by electric power.

Findlay, O., has let its street-lighting contract for five years at $69.50 per year for arcs and $12 per year for incandescents.

Gloucester, Mass.—The street lighting committee has in hand the matter of a separate arc circuit for East Gloucester, Mass.

The Newburyport (Mass.) Electric Light and Power Company voted to increase its stock and put in new machines.

Galnesville, Tex.—Bids are requested for lighting the city by electricity, as per details to be furnished by R. S. Rollins, mayor.

Reynoldtown, Pa.—George Altmeyer has been granted a franchise to erect poles and string wires for electric lighting purposes.

Springfield, Mo.—The Springfield Electric Light Company and the Springfield Gas Company have consolidated. Capital, $160,000.

Annapolis, Md.—The Baltimore *American* calls attention to the fact that the city of Annapolis is without a contract for its electric lighting.

The Lancaster (Pa.) Citizens' Electric Light, Heat and Power Company, has commenced work on their plant. Westinghouse apparatus will be used.

Bladensburg, Md.—The Town Commissioners are getting estimates in the matter of a municipal electric lighting plant, prior to laying the matter before residents.

Austin, Minn.—The new firm which has bought out the Austin Electric Light Company are George C. Duffie and W. S. Pierce, one of the founders of the original company.

Columbus, O.—The Trustees of the Institution for the Blind have rejected all bids which were presented for the erection of an electric lighting plant and will advertise again.

Tannersville, N. Y.—The Hunter Electric Light and Power Company is to be located at Tannersville within four months, and Frank Haines, of Hunter, Greene county, is now making contracts.

The Jamestown (N. Y.) Electric Light and Power Company has sold all of its stock except that owned by C. W. Grant to N. W. Gokey & Son, who will unite it with the plant in their shoe factory.

Rock Island, Ill.—The Rock Island Council Committee on Fire and Light has reported in favor of advertising for bids for furnishing low lights and tower lights, and the matter was laid over till next meeting.

Flatbush, L. I., N. Y.—The Flatbush Town Board has granted permission to the Knickerbocker Electric Light and Power Company to string wires and erect poles. Richard Ficken, of Flatbush, is president of the company.

Lowell, Mass.—The Lowell *Citizen* calls attention to the fact that the contract for street lighting with the Lowell Electric Company expires Aug. 1, and that steps should be taken in the matter of securing a municipal electric light plant.

Schaghticoke.—The Schaghticoke Powder Company will begin next week to make extensive additions to its plant, and will change the motive power to electricity. Five new mill wheels will be erected, to be constructed entirely of iron.

Toledo, O.—Architects Baker and Huber have the contracts for the improvements to the retail store of Lasalle & Koch at Adams and Summer streets. The block will be wired for incandescent electric lighting and electric elevator.

Middletown, N. Y.—The Middletown Pipe Line and Power Company propose to utilize the power of the Neversink River to furnish electricity for street lighting and power purposes to Middletown. The incorporators are W. D. Straiton, E. M. Willis, H. W. Corey and E. A. Brown.

Cedar Rapids, Ia.—Proposals are invited to 12 noon Aug. 9 for lighting the streets of the city for the term of three or five years with electric arc or incandescent lights, beginning Jan 1894. Parties will be encouraged to erect a first-class electric r lighting plant, with acceptable option to sell same to the city at end of contract at the price for which a similar plant can be duplicated at the time. J. L. Hardwick is chairman of the Board of Public Works.

THE ELECTRIC RAILWAY.

Lockport, N. Y.—Work has been begun on the electric street railway for Lockport.

Norfolk, Va.—It is stated on the best authority that the Suburban & City Railroad of Norfolk will extend its tracks to Berkley.

Portsmouth, O.—The contract for the electric road to New Boston and Sciotoville has been awarded to Mr. Whiteley, of Springfield.

Medford, Mass.—The Aldermen of Medford have granted permission to the West End Railway to run cars by electricity on 22 conditions.

Columbus, O.—The ordinance granting permission to the Crosstown Street Railway Company to extend its tracks on Central avenue was passed.

Gettysburg, Pa.—Work on the trolley road that has been desecrating the battlefield has been stopped, and the contract abandoned by Duerr & Co.

Port Jervis, Md.—It is reported that the New York Cottage Company will build an electric road from Port Jervis, by way of Milford, to Stroudsburg.

Rapid Transit in Boston.—The project of a subway under the streets of Boston, to be first constructed under Tremont street, is being discussed by the newspapers.

Carlisle, Pa.—O. H. Ormsley, of Altoona, Pa., and Dr. S. R. Ickis, of Pittsburgh, Pa., are before the Town Council and state that they wish to build an electric road here.

Lockport, N. Y.—Wm. Bell, of the Sanborn road, and Dr. Lapp, of Clarence, are canvassing for subscriptions to the stock in the proposed electric road to Buffalo. They have raised $12,000.

Woodbury, N. J.—The city council has refused permission to the Camden, Gloucester & Woodbury Railroad, controlled by Wm. J. Thompson, the "Duke of Gloucester," to cross the city with a trolley line.

Highland, N. Y.—Work has been stopped on the electric road on account of the financial stringency. The road is nearly completed, the power house being up, the road graded and the ties and trolley poles strung along the line.

Washington, D. C.—Efforts are being made to sell the Washington & Arlington Electric Railway. No price has been officially placed upon it. The most valuable asset of the company is a franchise to build a bridge across the Potomac.

Pittsburgh, Pa.—J. A. McCormick, one of the prime movers in the matter of the proposed inclined road for Mount Washington, states that $150,000 will be required to equip the road and that $40,000 has been subscribed and a charter applied for.

York, Pa.—The first steps toward building the electric road to Dover are being made. Aldinger, Son & Sprenkle, civil engineers, are surveying the proposed route, and as soon as estimates can be made active steps will be taken towards the building of the line.

Philadelphia, Pa.—The capital stock of the Electric Traction Co. has been increased to $2,500,000. This is the corporation which was organized for the purpose of leasing and equipping with the trolley system the various lines operated by the Frankford & Southwark Street Railway Co.

Gloversville, N. Y.—A new road will be built to connect Fort Johnson, Amsterdam, Johnstown and Gloversville, and among those interested are Lawton Caten, of Gloversville. It is likely that steam will be used for freight cars and electricity for passenger coaches. The route has not yet been chosen.

Baltimore, M. D.—The Baltimore, Middle River & Sparrow's Point Railway Company has applied for right to build a road, to be operated probably by electricity, to Sparrow's Point, the capital being $100,000, and the directors are Major Thomas B. Gatch, F. W. Trimble, J. J. Forrester, J. S. Hopkins and Geo. R. Willis.

Baltimore, Md.—It is now stated on good authority that work on the Baltimore & Drum Point Electric Railway will be commenced within a few weeks. It will be remembered that the road was graded several years ago, and under foreclosure was purchased by Edward Lauterbach, of Hoadley, Lauterbach & Johnson, of 120 Broadway, New York.

Havre, France, will have a trolley electric railway shortly. It is to be installed by the French Thomson-Houston Electric Railway Company. There will be 40 cars, 24 of which will each have one motor of 25 h. p., and 16 cars two motors each of 25 h. p. The generating plant consists of three Farcot horizontal engines driving three Thomson-Houston dynamos of 200 kw., each of 525 volts.

PERSONAL NOTES.

Prof. S. P. Thompson arrived in New York from England on Saturday, July 29, and left the same day for Chicago.

Harold B. Smith, of Barre, superintendent of the draughting department of the Electron Company, of Springfield, has accepted the professorship of electrical engineering in Purdue University Lafayette, Ind. Prof. Smith is a graduate of Cornell, '91.

MISCELLANEOUS NOTES.

The Electrical Census Report, it is rumored, will be published in part in the near future.

A co-operative electrical factory, it is reported, will be started by Swedes in New Haven, Conn.

San Bernardino, Cal.—It has been proposed to utilize the water power of the Grand Canyon of the Colorado River to propel steamers by a trolley system 500 miles long, and for irrigating purposes.

Mr. Allen R. Foote has received very flattering letters in regard to his great work on the law of incorporated companies operating under municipal franchises, and the sales promise soon to recoup him for the unusually great outlay necessitated to insure correctness and cover the entire ground.

The American Institute of Electrical Engineers, through its secretary, Mr. Ralph W. Pope, has issued an exceedingly neat little pocket edition of its catalogue containing the officers of the society, a complete list of members, classified both alphabetically and geographically, the rules of the association and calendar of the meetings of the ensuing year. This catalogue is sent only to those members who have paid their dues for this year.

The General Electric Company, through President Coffin, denies the report that there is ill feeling between the Edison and Thomson-Houston branches, and states that with the exception of two officers all the officials in the New York office are former Edison men. He confirms the report that $100 fee is charged at Lynn for admission to the expert course.

Electricity for Harbor Lights.—The experiment of using electricity for channel lights is found to be successful by the Lighthouse Department on Staten Island. From a dynamo on Sandy Hook wires are run under water, and supply 150 volts to a double row of lights, red on the right and white on the left, entering George's Channel in the lower bay. Electric apparatus has been introduced into four new lighthouses to test its economy and reliability.

A new electric railway system, invented by Thomas Harris and being experimented with at Detroit, is described by a local paper as follows: The current is applied by means of an underground wire to an underground switch, which is connected with a third rail, running through the centre of the track. This third rail is not continuous, but laid in sections, none of which are "live" or dangerous except the one over which the car is passing. As the sections of rail are only eight feet in length and the smallest car about twenty feet, it will be seen that all danger from contact with the live section is entirely obviated. The third rail being connected with automatic switches one section of rail becomes "dead" as soon as the car passes to the next section. Beneath the car are arranged two brushes, fore and aft, which are just far enough apart to insure the car reaching one section of third rail after leaving one. It will be seen, therefore, that the car must be present to make any section of rail active, and then the rail is covered by the car. The wires are entirely buried, and therefore cannot come in contact with anything which could be harmed. The operating switches can either be placed inside the rails or in an alley running parallel with the street, thus doing away with the necessity of digging up the street should anything get out of working order.

Trade and Industrial Notes.

The Electric Appliance Company, of Chicago, reports that the demand for the swinging ball lightning arrester continues as brisk as ever, although the season is now well advanced.

The Wrought Iron Bridge Company, of Canton, O., has issued a neatly printed 76-page catalogue, containing 68 illustrations of the works and bridges, car sheds, etc., built by them.

The Chicago Insulated Wire Company, Sycamore, Ill., has issued a catalogue and price list of the classes of insulated wire manufactured by it, consisting of weatherproof copper and iron wire, magnet wire and annunciator and office wire.

The Ansonia Electric Company, of Chicago, reports that sales are on the steady increase, notwithstanding the closeness of the money market, and the outlook for fall trade was never better. It has from three stations the promise of orders in the very near future aggregating about $25,000.

The Stirling Company, F. A. Scheffler, general sales agent, 71 Cortland street, New York City, reports the following sales of boilers during the last week: Minneapolis Electric Company, Minneapolis, Minn., 750 h. p.; J. G. Mattingly Company, Louisville, Ky., 750 h. p. (second order); Taylor Chair Company, Bedford, O., 150 h. p.

The General Electric Launch Company, 44 Broad street, New York, will make another electric launch for the U. S. S. New York, the Secretary of the Navy having offered the one built for that ship to the Russian flag ship Dimitri Donskoi. One of the two launches now building for the Russian ship will be delivered to the New York in return.

The E. W. Bliss Company, Adams street, Brooklyn, N. Y., sends us copies of the handsome 9 × 12 inch catalogues it has prepared for the benefit of foreign visitors to the World's Fair. These are five in number, with descriptions in English, French and German of the different presses and drop-hammers for which this firm has obtained a world-wide reputation.

The S. S. White Dental Company, Philadelphia, has issued a 16-page pamphlet devoted to the Partz primary battery. The various forms of this excellent battery are illustrated and copious information given in regard to the same. Having proved so successful in dental work the manufacturers are now placing the battery on the market for general use where a constant current, particularly of large quantity, is desired.

Henry R. Worthington, 86 Liberty street, New York, has issued a 104-page catalogue of Worthington pumping engines, steam pumps, hydraulic machinery, condensers and water meters. We notice a fac-simile of the grand prize awarded to this company at Paris in 1889, where grand prizes were rare indeed. Views are also given of the enormous Worthington pumping engines at the World's Fair, as well as of the Worthington pumping station.

Queen & Co., Incorporated, Phila., Pa., have issued a fourth edition of their electrical apparatus catalogue, printed upon excellent paper. The well executed cuts produce a remarkably pleasing effect, while the descriptive matter is clear and concise. A number of new standard instruments, designed in the Queen laboratory, are here shown for the first time. Examples of all the important pieces are exhibited by the company at the World's Fair.

Municipal Lighting Plant.—Mr. C. O. Mailloux stated before a Rome, N. Y., city lighting committee that in Madison, N. J., the city put in its own plant and sold electricity for private lighting and for commercial purposes. It was sold so cheaply that the demand was great. The city was compelled to double its plant. The revenue is so great that a sinking fund has been created with which to pay off the bonds issued to build the plant. The city gets its light for a nominal figure.

The Campbell & Zell Company, Baltimore, Md., is distributing at the World's Fair a viewbook of the World's Columbian Exposition, giving illustrations of all the principal buildings in the Fair Grounds, together with a large amount of information as to the points of interest, location of prominent buildings, etc., about Chicago. On the back of the souvenir is shown the plant of 2,850 h. p. composed of Zell improved water tube safety boilers erected by this company in the main power house at Machinery Hall and equipped with patent controlling burners for using crude petroleum.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 195 South Warren street, Syracuse N. Y.

Notice.—The electric light plant heretofore owned and operated by A. W. Wright, at Alma, Mich., has been purchased by the undersigned, to whom all communications should be addressed.

ALMA SANITARIUM CO.
(Electrical Department),
ALMA, MICH.

The Electric Storage Battery Co. vs. the Consolidated Storage Co.—The correspondence here given, especially in connection with the recent storage battery patent decision, is of interest. The following communication, signed by Wm. Bracken, president of the Consolidated Electric Storage Company, and bearing date of Feb. 27, 1893, was received by Geo. W. Pearson, Esq., president of the Metropolitan Railroad Company, Washington, D. C.:

I am informed (though the information may not be correct) that you are treating with Mr. Gibbs' company for the use of the Laurent-Cely battery on your road, and I avail myself of the first opportunity to inform you that that battery is a clear infringement of the Brush patents. Of this there is no earthly doubt, no matter what representations may be made to you on the contrary. They cast a lead form or support around tablets of active material. They call those tablets by another name than "murium" and "metalic" "lead," but there is nothing in the name. They are mufium, a peroxide and metallic lead, or become so as soon as the battery is put in operation. Even if the tablets were any other material than oxides, they would still be an infringement so long as they are *active material or absorbtive substance.*

I again inclose you our printed circular letter of Oct. 25, 1892, and would call your attention to the 12 claims therein of the Brush patent, No. 337,299.

This letter brought forth the following reply from W. W. Gibbs, president of the Electric Storage Battery Company, Drexel Building, Philadelphia, Pa., dated July 27, 1893, and addressed to Mr. Wm. Bracken:

I am favored with copies of your letters of Feb. 27 and July 24 to Mr. George W. Pearson, president of the Metropolitan Railway Company, of Washington, D. C., wherein you state that the battery manufactured by the Electric Storage Battery Company, of Philadelphia, is a clear infringement of the Brush patents, and of which "there is no earthly doubt."

There may be no doubt in your mind. This is not surprising, as you seem to be completely ignorant of the state of the art as applied to the manufacture of storage batteries but you will find the very greatest legal doubt when you come to take the advice of competent lawyers and experts who are familiar with the state of the art, and do not rely upon your statements. No competent lawyer or expert can honestly advise you, with a full understanding of our battery and your Brush patents, as construed by the courts, that our battery infringes any claims of your Brush patent.

You show your ignorance of our battery when you say "They cast a lead frame or support around tablets of active material," for we do nothing of the kind. Our tablets are not of active material when the frame is cast around them; and that even you ought to know, considering the experience you are supposed to have had with storage batteries. Our active material is formed out of the tablets by electrical disintegration after the tablets are cast and the frame cast around them. Again, the claims of your Brush patent, as construed by the courts, are not for "active material of absorptive substance," but for a "plate or suitable support primarily coated or combined with mechanically applied active material or material adapted to become active," as you, no doubt, knew, and should have said had your desire been to truthfully advise Mr. Pearson, instead of to deceive him to our injury.

By what authority do you say our battery infringes the claims of your Brush patent? Surely on the authority of no court, for you will know that no court has declared our battery to be an infringement, and although we have been, to your knowledge, openly engaged in manufacturing our batteries for some years, you have not, down to this moment, proceeded against us, although threatening to do so for nearly eight months past. You apparently propose to dispose of our battery and business without resorting to the courts, wherein such questions are usually determined. Undoubtedly this is the safest way for you, considering that our battery is totally unlike any battery yet held to be an infringement of your patents, and that it is a battery 100 per cent. better in every particular than any battery ever manufactured by you or under your patents. It certainly is a great burlesque on your intelligence or the intelligence of your engineers that we are able to manufacture a battery 100 per cent. better than any you ever produced, if any features of your patents are employed by us.

Unlike you, we have sufficient confidence in our position to submit the question to the courts empowered to consider and determine such questions, and there we invite you to meet us at once, and unless you do so, or discontinue your libelous statements against our battery, we shall take such steps as we are advised are open to us to protect our interests.

We are advised by our counsel and experts that our battery does not infringe any of the claims of your patents, and having confidence in their opinion we propose to continue making and selling our battery, and shall protect and save harmless all users of them, not only as against any claim you may make, but against all claims from whatever source.

Now, being advised of our intentions, we demand, in view of statements made in your letter to Mr. Pearson, and to other parties that you proceed at once against us on a bill for infringement, accompanied with motion of injunction, so that the question of our infringement of your patents may be determined, and to that end we advise you, viz.:

We are a New Jersey corporation, with a factory at Gloucester in that State, where batteries are being manufactured daily, and we will at any time furnish you with one of our batteries, at the usual price, accompanying same with a sworn statement of precisely how they are made, with permission to use the same in any proceedings against us.

We have, to avoid delay, authorized our counsel, Mr. John R. Bennett, Potter Building, New York City, to accept service of papers in our name and to aid you in every way possible to reach the courts at the earliest possible moment, and you can arrange with him, either direct or through your counsel, for one of our batteries and a statement of its construction.

If you have confidence in your position you will, of course, accept our most reasonable proposition to proceed against us at once, and if you do not, we hereby notify you that we shall proceed against you to protect our interests, holding you responsible for the damages resulting to our business by the making of statements, and the sending out of such unfounded libelous letters as you have sent to Mr. Pearson.

In connection herewith is given the report of Prof. C. F. Chandler, of New York, on the chloride accumulator, manufactured under patents owned by the Electric Storage Battery Company, of Philadelphia, embodied in a letter addressed by that gentleman to W. W. Gibbs, Esq., president of the Electric Storage Battery Company:

In reply to your inquiries as to whether your chloride accumulator itself, or the process by which it is manufactured, or the way in which it is used, in any way infringes the Brush secondary battery patents, or any of them, I would make the following report:

Having been engaged as an expert in the litigation between the Brush Electric Company, the Julien Electric Company and the Electrical Accumulator Company, I am quite familiar with the Brush patents and with the interpretation which has been put upon them by the judges of the United States Circuit Court and Circuit Court of Appeals.

Manufacture of the Plates for the Chloride Accumulator.—As I am informed the chloride accumulator plates are manufactured in the following manner:

1. *Mechanical Construction of the Plates.*—Chloride of lead and chloride of zinc, mixed in the proper proportions, are carefully fused and cast into rectangular tablets of a suitable size thickness and shape. These tablets may be then subjected to such treatment as will withdraw the chloride of zinc, and at the same time decompose the chloride of lead, and thus convert the tablets into plates suitable for use in storage batteries, without any further mechanical treatment.

It is customary, however, to first incase the tablets in a frame of metal, which serves to hold them rigidly and protect them from injury in handling. This is accomplished by placing the tablets of chloride of lead and chloride of zinc in a suitable mold, and pouring in a melted alloy of lead and antimony, which flows around the tablets, and on congealing forms a frame in which, owing to their peculiar form, the tablets are firmly and permanently fixed.

2. *Conversion of the Tablets into Material Suitable for Immediate Use in Storage Batteries.*—The above constructed plates of chloride of lead and chloride of zinc are not capable of use in a storage battery.

They are not capable of serving as oxygen plates, as they will not absorb oxygen. They are not capable of use as hydrogen plates, as not only would their immersion in the dilute sulphuric acid of a storage battery cell result in contaminating the fluid with chloride of zinc, which would be fatal to its proper action as a storage battery fluid, but the effect of the hydrogen liberated would, if any action took place, be to form hydrochloric acid with the chlorine of the chloride of lead, which hydrochloric acid would further contaminate the fluid and make it inoperative as a storage battery fluid; moreover, these tablets are non conductors of electricity.

It is evident, therefore, that the plate of tablets consisting of chloride of lead and chloride of zinc is worthless in its present condition as a storage battery plate, and cannot be used as such. Its chemical composition must first be radically changed in order to fit it for service in a storage battery, either as an oxygen or as a hydrogen plate. This chemical change is brought about by means of a bath of chloride of zinc or some equivalent substance, in which the plate of tablets is to be immersed, in connection with a slab of metallic zinc. This arrangement is, in fact, a primary battery in which the zinc acts as the positive element, while the tablets constitute the negative element.

The chemical action in this combination results in withdrawing the chloride of zinc from the tablets by simple solution in the bath, and the withdrawal of the chlorine of the chloride of lead from the tablets and the fixing it in combination with the zinc with the formation of chloride of zinc.

The chloride tablets in the plates are not in any sense active material, nor are they material capable of becoming active in a secondary battery fluid.

They only constitute material which may be subsequently rendered active by the electrical disintegration which is brought about when they are connected with the zinc plates in the bath of chloride of zinc. When the process of electrical disintegration is complete and we have washed all the chloride of zinc out of the plate, we have a mass of metallic lead which is suitable for immediate use in a storage battery, without the tedious forming process of Planté and without the application of any active material or material about to become active by the processes of Brush or Faure. It is simply necessary to couple these plates up, half of them in connection with the positive electrode, and half in connection with the negative electrode of a dynamo, in a cell containing dilute sulphuric acid, and then to proceed to charge them in the usual way. The plates connected with the positive electrode will be charged with oxygen and converted into peroxide of lead, while the plates connected with the negative electrode will be charged with hydrogen. On disconnecting the charged plates from the dynamo, the battery will be ready to deliver a current of electricity whenever the circuit between the oxygen and the hydrogen plates is closed. The battery may then be discharged and recharged as often as may be desired, or the plates after they are charged may be transported to any point at which their use as generators of electricity may be desired.

The Brush Patents.—The Brush patents have been repeatedly before the courts, and have been finally considered and sustained by the Circuit Court of Appeals in an opinion by Judge Shipman, wherein the claims have received their true legal construction.

According to this, the latest decision with regard to the Brush patents, a storage battery plate, in order to infringe the claims of the Brush patent, must consist of a support of conducting material and an absorptive material, either active or ready to become active, which has been primarily and mechanically applied to and combined with said support.

If it be said that your plates, when they are ready for immersion in the fluid of the secondary battery, consist of a support in combination with material ready to become active, and are consequently Brush plates, it is evident that they are not the plates of the claims of the Brush patents, because the material to become active has not been, at any stage, primarily and mechanically applied; on the contrary, it has been produced in place of electrical disintegration in the same manner substantially as were the plates of Planté, the only difference being that Planté produced his from sheets of metallic lead, while you produce yours from tablets of chloride of lead and zinc.

You construct a composite plate consisting of tablets of chloride of lead and chloride of zinc in a frame of metal. There is no active material in this composite plate, nor is there any material ready to become active in a secondary battery. Nor is there any material which is absorptive in a secondary battery.

In fact, as far as any use of this composite plate in a secondary battery is concerned, it is practically inoperative and worthless. Before any use can be made of this composite plate it must be exposed to a process of electrical disintegration, not in the bath or fluid of a secondary battery, but in a totally different bath in connection with plates of zinc. And only after this electrical disintegration is the plate of any use in a secondary battery.

My understanding of the Brush claims is confirmed by [the language of Judge Shipman, which reads as follows:

"The mechanical application of a layer of lead oxide to each of two lead plates before the plates are placed in the battery fluid, these coatings being at once active material and ready for the charging current, when immersed in the battery fluid, was, in general terms the distinguishing feature of the Brush invention. . . . . These claims describe and necessarily refer to a secondary battery, as heretofore defined; a plate or support, which is insoluble in the liquid, mechanically supports the active material and electrically conducts the current of electricity through it; the specified active or absorptive material being oxides of lead which are primarily mechanically applied to the plates, and in such state of minute division as to be at once capable of being charged without previous process of 'formation' by electrical disintegration."

In conclusion, I am, therefore, of the opinion that your battery does not, either in itself, in the process by which it is manufactured, or in its use infringe the claims of the Brush patents.

I am familiar with all the batteries that have been held to infringe the Brush patents, and in all of them the distinguishing features of the Brush invention, as set forth in the above quoted passages of the opinion of the Court of Appeals, were clearly present.

No battery such as yours has been held to be an infringement of the Brush patent, and from my understanding of the opinion of the court of last resort, the Circuit Court of Appeals, such conclusion would be impossible.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JULY 11, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

501,049. Commutator Connection; N. C. Bassett, Lynn, Mass. Application filed Feb. 9, 1893. The cross connections of a commutator for dynamo electric machines and motors, assembled in an arbor adapted to be mounted upon the shaft between the armature and commutator; the connections proceeding at an angle around the arbor, and having parts overlying and underlying each other respectively.

501,059. Regulator for Dynamo-Electric Machines; W. H. Elkins, Cambridge, Mass. Application filed June 23, 1892. The combination with a dynamo-electric machine having two sets of brushes bearing on its commutator with independent brush shifting devices for such sets of brushes, of two working circuits connected respectively to such sets of brushes, and each having connections to the field coils, and a shunting switch for each of said circuits.

501,060. Brush for Dynamo-Electric Machines and Motors; J. P. B. Fiske, Lynn, Mass. Application filed Jan. 31, 1893. The combination with a commutator of two or more brushes of relatively high and low resistance, bearing on different parts of the commutator segment, the brush nearest the armature being of low resistance.

501,068. Electric Snap Switch; Caryl D. Haskin, Lynn Mass. Application filed Jan. 24, 1893. In an electric snap-switch a switch mechanism adapted to hold under tension a spring composed of a single piece of wire coiled at its extremities and engaged by its middle portion, in combination with a trigger securing the switch handle and adapted to be operated by a galvanic circuit.

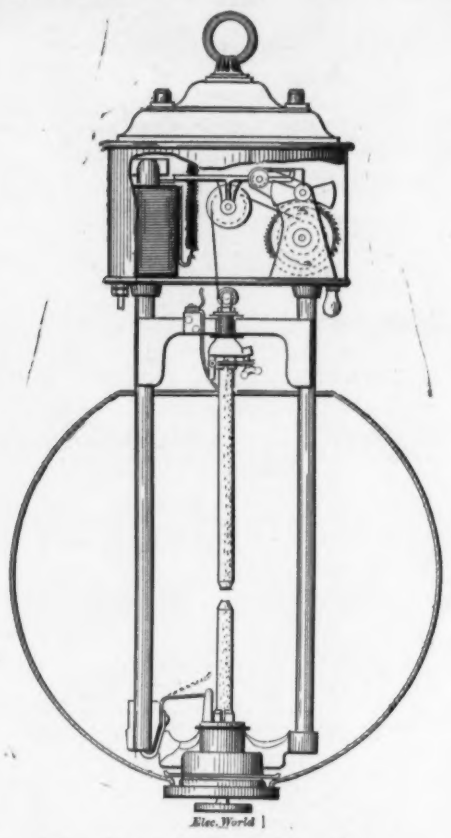
501,071. Electric Switch; Carl F. W. Hofer, Berlin, Germany. Application filed March 25, 1891. A circuit closing key, comprising opposite pairs of contacts, a reciprocating plunger or part, and switch levers or devices pivoted to the plunger and having sliding or rubbing action on the contacts.

501,074. Electric Arc Lamp; Josef Jergle, Vienna, Austria. Application filed Nov. 25, 1891. In an arc lamp the combination with a cross-head carrying the positive carbon of a vertical screw threaded rod engaging an open nut on the cross-head, a horizontal disc on the upper end of the rod, actuated by a step-by-step feed consisting of an armature lever pivoted on the rod, a shunt magnet parallel to the lever, and a pair of roller clutches each of which under the action of the shunt magnet and its armature is adapted to alternately engage and disengage the disc to rotate it.

501,080. Electric Arc Lamp; George Kirkegaard, Brooklyn, N. Y. Application filed Nov. 12, 1892. In an arc lamp, a pivoted frame carrying a train of wheels geared to the carbon c.rrier, a detent for said train of wheels, a pivoted lever operating said detent, a link or other device connecting the frame and the lever at such a point that a movement of the detent will be greater than the simultaneous movement of the frame, an electromagnet and spring, respectively connected with the lever and frame, and acting in opposition thereupon.

501,081. Electric Arc Lamp; George Kirkegaard, Brooklyn, N. Y. Application filed Feb. 20, 1893. In an arc lamp, the combination with a hollow carbon rod of a carbon holder having a split shank projecting into said holder, and a screw or wedge entering the shank axially, to spread it and thus hold it in the rod. (See illustration.)

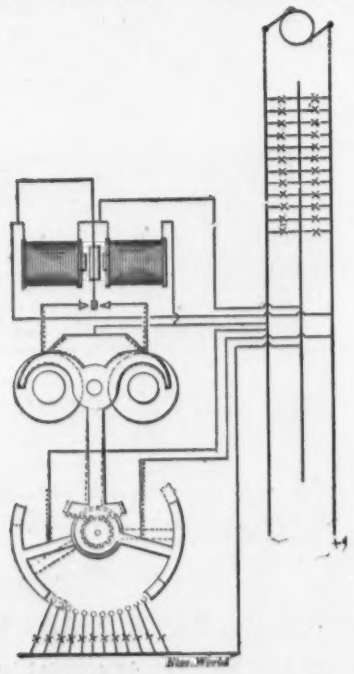
501,085. Telephone Circuit and Apparatus; S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J. Application filed March 20, 1893. The combination of a main double conductor telephone circuit extending between an end orcentral station and a series of sub-stations provided at the sub-stations with plug socket terminals; a line condition device connected with or in the circuit at each sub-station; a suitably located battery or equivalent source of electricity; an earth branch conductor including the said source of current, provided with connecting plug terminals adapted to be inserted in the plug sockets, and thereby to simultaneously close the main circuit and the earth branch circuit, including the source of electricity.



No 501,081.—ELECTRIC ARC LAMP.

501,086. Station Apparatus for Telephone-Circuits; S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J. Application filed March 20, 1893. The combination of a main double conductor telephone circuit extending between an end or central station and a series of sub-stations and provided at the sub-stations with plug socket terminals, a secrecy device or apparatus, and a line in use indicator, connected with the circuit at each sub-station; a suitably located battery or source of electricity; an earth branch conductor including the source of current, provided with connecting plug terminals adapted to be inserted in the plug sockets, and thereby to simultaneously close the main circuit and the earth branch circuit including the source of electricity.

501,087. Electric Signaling; T. D. Lockwood, Melrose, Mass., and S. J. Larned, Evanston, Ill. Application filed March 27, 1893. The combination of a series of main double conductor telephone circuits extending between an end or central station and a series of sub-stations, provided at the central station with calling keys, one for each side or limb of the main circuits; and an earth branch conductor including a source of electricity; a selective signal device or apparatus at each sub-station connected in earth branches from two separate sides or conductors of said main circuits and adapted to operate a signal indicator upon the union of the two calling keys associated with the two conductors at the central station with the earth branch.



No 501,095.—ELECTRIC LIGHTING SYSTEM.

501,094. Equalizer for Rotary Current Systems; Paul Nordmann, Berlin, Germany. Application filed Feb. 23, 1892. An equalizer for multiphase current systems, comprising a laminated core, the core having a coil wound thereon, divided into as many sections as there are current phases, the sections connected in successive order to the main line conductors.

501,095. Electric Lighting System; P. Nordmann, Berlin, Germany. Application filed Nov. 18, 1892. In a system of electrical distribution of a source of energy, main wires and an intermediate wire, and translating devices in parallel between the main wires and the intermediate wire, the translating devices being in parallel series between the main wires, a relay magnet connected to the opposite sides of the system and another magnet controlled by the relay magnet, and a variable resistance controlled by the second magnet, so connected as to be cut in and out of each side of the system according to the variations of the load in order to maintain the potential constant in the respective groups. (See illustration.)

501,102. Telephone Signaling Apparatus and Circuit; F. A. Pickernell, Newark, N. J. Application filed March 20, 1893. The combination with a main telephone circuit extending from a sub-station to a central station; a telephone at the sub-station; a suitably located source of calling currents; and switching devices at the said sub-station, adapted to connect the telephone and the said source of calling current with the main circuit, and to disconnect them therefrom; of a double acting central station electromagnetic annunciator constructed to retain its signal shutter drop in place in an electrical condition of the line so long as such condition remains unchanged, but adapted to release the same and give the signal of any change in such condition.

501,114. Lightning Arrester; E. Thomson, Lynn, Mass. Application filed June 20, 1890. In a lightning arrester, the combination of the line conductor with the tubular, sheet like discharge conductor connected to ground and surrounding the line conductor, and the self-induction coil between the apparatus to be protected and the point of connection between the line conductor and the tube.

501,117. Dynamo-Electric Machine; H. L. Tyler, Corning, N. Y. Application filed Oct. 17, 1892. In a magneto-electric machine, the combination with a stationary armature, having a series of separate and independent induction coils, a rotating multipolar field magnet revolving within the armature, and a non magnetic cylindrical case inclosing the entire exterior portion of the field magnet. (See illustration.)

501,144. Ammeter; W. Hochhausen, Brooklyn, N. Y. Application filed Feb. 28, 1891. In an ammeter or voltmeter, an electromagnet the spool of which is composed of a casting of conducting material, and is included in the electric circuit of the magnet coils.

501,151. Electric Battery; J. H. Mason, Brooklyn, N. Y. Application filed Nov. 14, 1892. The combination with a cell of a carbon element, having the central post and radial portions, a cup having a porous bottom and supported by the carbon element, and the zinc element supported on the bottom of the cup.

501,168. Telephone-Switch; C. E. Scribner, Chicago, Ill. Application filed Dec. 27, 1886. The combination with a vibrating telephone switch having the shorter arm provided with two bearing surfaces, one metallic and the other of insulating material, the bearing surfaces being at different distances from the pivotal axis of the switch, of a spring contact adapted to constantly press against the shorter arm, the pressure of the spring being exerted upon only one of the bearing surfaces at a time, the particular bearing surface against which the spring is pressed being determined by the position of the switch lever.

501,169. Telephone Exchange Apparatus; C. E. Scribner, Chicago, Ill. Application filed June 6, 1888. In a telephone exchange the combination with telephone lines, each connected through a switch and annunciator to ground at the central office and at their outer ends with a subscriber's telephone outfit respectively, of a metallic circuit, a branch circuit to ground containing battery, and switching apparatus at the central office, whereby any subscriber may send current from said battery through his annunciator at the central office while the operator may send current from said battery through the bell of any subscriber wanted.

501,170. Duplex Electric-Arc Lamp; C. E. Scribner, Chicago, Ill. Application filed Oct. 27, 1890. The combination with two arc lamps in series in the same circuit of contact points controlled by the lifting mechanism of one of the lamps to be closed together when the same is energized, and a shunt or by-path about the other lamp including the said contact points, whereby one of the lamps is short-circuited during the operation of the other.

501,172. Manufacture of Incandescent Electric Lamps; E. Thomson, Swampscott, Mass. Application filed Aug. 5, 1892. An apparatus for expelling residual air from incandescent lamp bulbs, which consists of a box having a lid adapted to support the lamps, and a furnace for heating the contents of the box to the desired high temperature.

501,173. Electric Switch; F. A. Thum. Application filed March 14, 1893. In a switch, the combination with the base plate, of four substantially parallel metal strips arranged on the base plate, and provided at opposite ends with upwardly extending portions adapted to form contact surfaces, a segmental shaped switch block pivotally arranged above, and at right angles to the said metal strips, and provided with three contact points, adapted to alternately engage the contact surfaces of the metal strips, and means for controlling the switch block in its various positions.

501,183. Electric Signaling Circuit; W. Daves, Jersey City, N. J. Application filed May 2, 1892. The combination of an electrical instrument, electrically connected to a binding post, a conducting wire connected to another binding post, and a spider wire joining the two binding posts, the spider wire receiving orifices of the binding posts being adjusted to the diameter of the spider wire and so as not to permit the insertion of heavier wire.

501,185. Visible Signal; F. W. Dunbar, New York, N. Y. Application filed May 4, 1893. An annunciator or visible signal indicator consisting of an electromagnet having angular polar extensions; an armature overlapping both polar faces supported and normally retracted by a spring; and a signal shutter or target controlled by the armature and positively withdrawn from view by the retraction thereof, but released and permitted to fall into view when the said armature is attracted.

501,191. Switch for Electric Conductors; Olof Offrell, Middletown, Conn. Application filed Aug. 12, 1892. A stem having a central slot, and contact arms consisting of two strips of metal provided with interlocking portions received in this slot.

501,193. Commutator Brush Holder; A. J. Shaw, Muskegon, Mich. Application filed Feb. 17, 1893. The combination of a supporting block or casting provided with ways, a carrier adapted to clamp a brush, and mounted and movable in these ways, a lever fulcrumed on the block or support and having one end arranged to bear against the carrier, and a spring bearing against the lever.

501,194. Revolving Armature for Electric Machines; E. A. Sperry, Chicago, Ill. Application filed Jan. 8, 1892. A shaft having a squared portion, insulated discs provided with square apertures fitting this squared portion, grooves in the discs entering from the periphery toward the centre, and flanges of less diameter than the discs, on either end of the armature, provided with means for forcibly compressing the discs.

501,195. Electric Locomotive; E. A. Sperry, Chicago, Ill. Application filed April 29, 1892. In a power gearing, an axle, a motor mounted on same, an elastic support between the motor and axle, a toothed gear or pinion mounted on the motor and co-operating gear mounted on the axle by a universal joint.

501,201. Automatic Circuit Interrupter; Alexander Wurts, Pittsburgh, Pa. Application filed Oct. 5, 1892. The combination of a switch composed of fixed and movable parts with a circuit interrupter composed of non-arcing metal in shunt on the switch and adapted to be operated by the movement of the movable part.

501,205. Socket for Incandescent Lamps; Axel Ekström Lynn, Mass. Application filed June 27, 1892. This comprises a socket and a base having a central non-circular projection, a contact carrying piece adapted to fit over the projection, and so hold the piece from rotation, and a shell adapted to clamp the contact carrying piece in place.

501,208. Electric Contact Apparatus; N. P. B. Fiske, Lynn, Mass. Application filed Aug. 12, 1891. A base having an undercut shoulder, a series of contacts bearing against such shoulder and a series of individually adjustable clamping devices for these contacts.

501,241. Lighting Arrester; J. E. Browne, Elizabeth, N. J. Application filed Sept. 12, 1892. The combination with a lightning arrester of two or more separated points, a frame or device for holding the points in place within an insulating envelope, and two or more rods attached to the points, the rods protruding from the case.

501,246. Electric Locomotive; W. E. C. Eustis, Milton, Mass. Application filed Nov. 5, 1891. An axle, and an electric motor, combined with auxiliary, driven by the motor, an actuating coil in circuit with the generator controlled by the armature of the coil to divert the current of electricity produced by the generator. (See illustration.)

501,258. Electric Circuit Closing Device; Wm. Sears, Boston, Mass. Application filed April 10, 1893. The combination of a trolley pole having electric contact plates insulated from each other and adapted to engage in electrical contact with the circuit closers; these circuit closers placed in the path traveled by the head of the trolley pole.

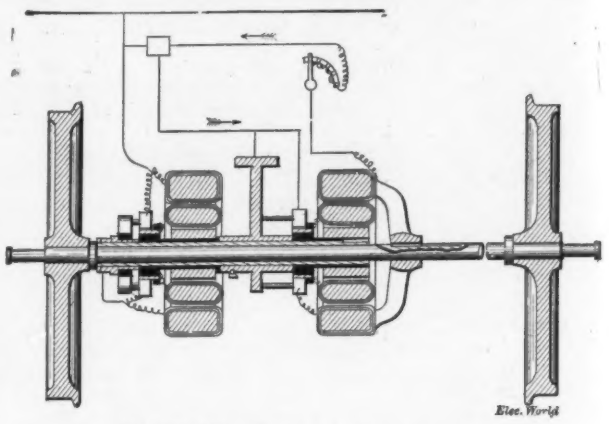
501,270. Letter Box; P. J. Fitzgerald, Hyde Park, Mass. Application filed Oct. 13, 1890. A metallic letter box divided into two compartments, in one of which is an electric battery; an electric bell, push buttons and wire connections, the box itself forming part of the circuit.

501,291. Electric Time Switch; J. F. McLaughlin, Philadelphia, Pa. Application filed Sept. 29, 1892. The combination of a spring actuated switch arm and two contact blocks in the path of same, and circuit connections whereby in one position of the switch arm one circuit is closed and another opened and vice versa; with a latch intercepting the movement of the switch arm in one direction, and a tripping mechanism actuated by an alarm movement for releasing the switch arm.

501,292. Electric Bell; W. J. Newman, Brooklyn, N. Y. Application filed Oct. 28, 1892. The combination of a base plate, an electromagnet, a yoke piece having an arm or projection by which it is fastened to the base plate, and a catch for the cover fastened beneath the projection.

501,306. Electric Alarm Money Drawer; W. J. Walker and A. L. Bedford, St. Louis, Mo. Application filed April 12, 1893. A lock composed of two movable plates hinged together, tumblers upon which one of the plates rests, a switch actuated by these plates, and an electric circuit in connection with the switch.

501,307. Railway Signal; Jas. Wayland, Newark, N. J. Application filed Jan. 21, 1892. The combination with the tread and signal and connections, of a speed pulley having curved segmental bearings formed to receive the connections in a single plane.



No 501,246.—ELECTRIC LOCOMOTIVE.

501,309. Method of Regulating Dynamo-Electric Machinery; M. J. Wightman and Herman Lemp, Hartford, Conn. Application filed Feb. 13, 1886. This consists in varying the relative potentials at the terminals, of a branch around a field magnet coil or portion of coil irrespective of the resistance of the branch.

501,376. Armature; J. J. Smith and G. W. Findlater, Jamaica, N. Y. Application filed May 26, 1892. A central ring having radially extending arms, circumferential bands carried at the ends of the arms, one of the bands having an end flange, and a series of removable bobbins tongued and grooved together and dovetailed into the ring.

501,388. Mechanical Telephone; E. W. Warren, Tyringham, Mass. Application filed Feb. 27, 1893. A diaphragm composed of adjacent discs of metal and rawhide.

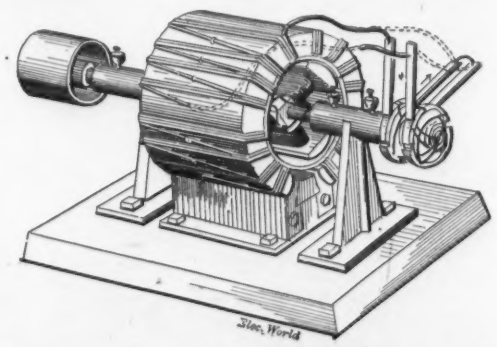
501,405. Support for Telephone Receivers; N. L. Burchell and Burnet L. Nevius, Jr., Washington, D. C. Application filed Nov. 3, 1892. The combination with a primary arm, pivotally connected, at one end, to a support, of a secondary arm telescoping within the primary arm, and a ratchet arm having a separate pivotal support and provided with teeth which engage a holding pawl on the primary arm.

501,438. Railroad Crossing Alarm or Signal; E. C. Potter, Vineland, N. J. Application filed April 6, 1891. In this invention but two circuit closing devices are employed in connection with the track circuit, these being simply starting devices, as the stopping of the alarm is dependent upon the action of the mechanical devices set in motion on the closing of the track circuit.

501,445. Junction Box; W. B. Sayers, Glasgow, Scotland. Application filed June 16, 1892. A junction box comprising a metallic receptacle, having integral therewith one or more lateral metallic extensions each formed with a pocket terminating in a neck, the neck and pocket being of U-shape in cross section and open at the top, and a socket arranged at right angles to the extensions and co-axial with the receptacle.

501,450. Electric Switch; L. T. Stanley, Brooklyn, N. Y. Application filed March 27, 1893. A door of the plate covering a recess in the jamb or frame, a socket, a plunger movable in the socket, a spiral spring acting on the plunger, a stationary contact within the recess, a pivotal contact and a flat spring having its ends connected to the inner end of the plunger and the pivoted contact.

501,472. Station Apparatus for Telephone and Telegraphic Circuits; Theo. Spencer, Cambridge, Mass. Application filed Feb 20, 1893. The combination in an electric circuit of a receiving telephone and a transmitting telephone at the same station; with means for preventing the side tone in the receiver when the transmitter is operated, the means comprising balancing resistances and circuit connections for the receiver whereby the receiver is connected between substantially equi-potential points of the circuit with respect to outgoing currents, regardless of variations in the electric condition of the main circuit conductors.



No. 501,117.—DYNAMO ELECTRIC MACHINE.

501,481. Trolley Wire Hanger; A. W. Meston, St. Louis, Mo. Application filed Oct. 31, 1892. In a clip plate for securing the trolley wire to the trolley hanger, the combination with the curved lips in which the wire is retained, of a raised rib on the inner side face of the clip plate.

501,482. Revolving Motor; H. L. Parker and A. W. Meston, St. Louis, Mo. Application filed Oct. 22, 1892. The combination with a revolvably supported motor, its armature shaft, and a fan secured on the armature shaft, of an encircling track with which the armature shaft is adapted to engage.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886 can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.